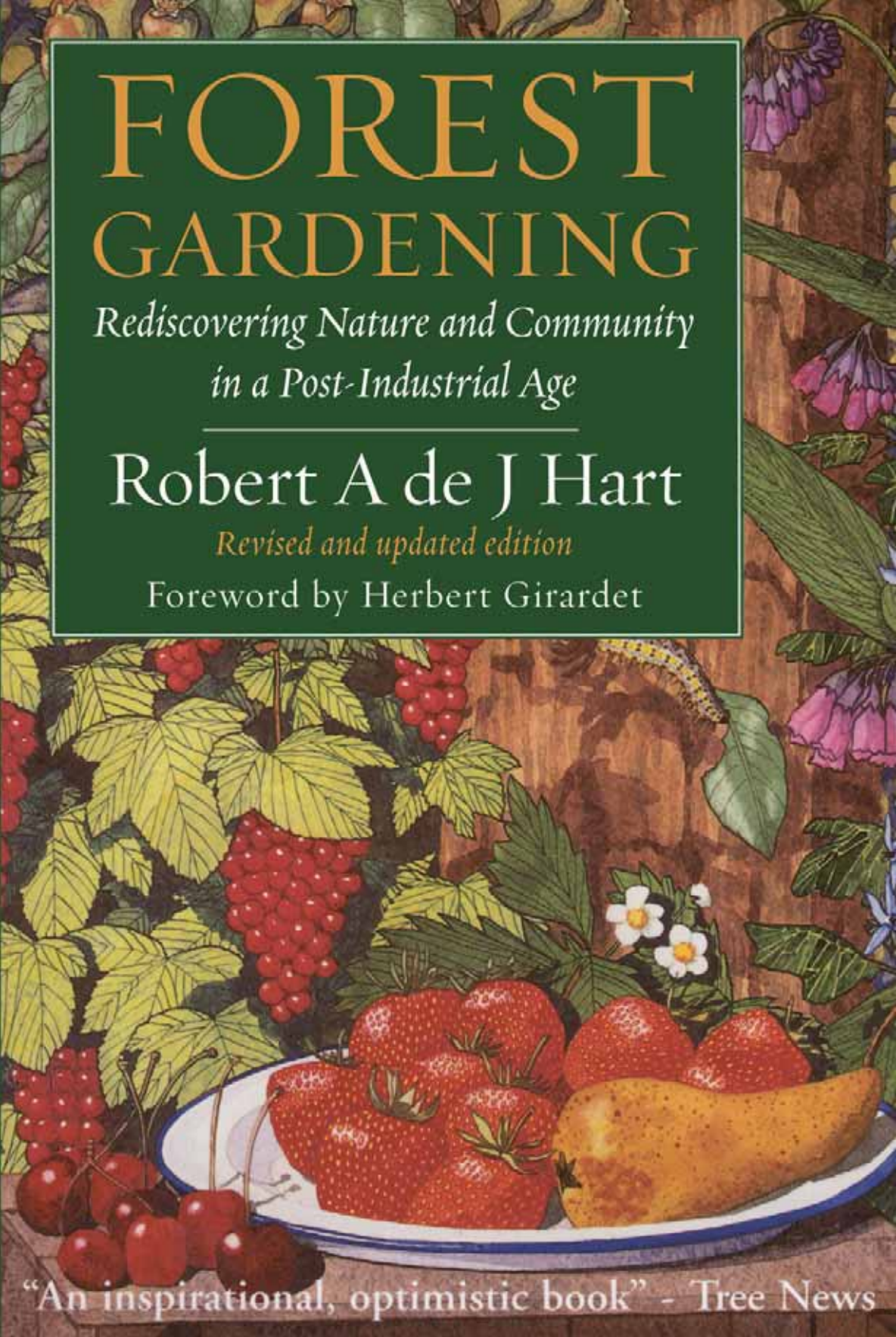
FOREST GARDENING

Rediscovering Nature and Community in a Post-Industrial Age

Robert A de J Hart

Revised and updated edition

Foreword by Herbert Girardet



"An inspirational, optimistic book" - Tree News

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ROBERT A de J HART

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green books

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To ELENA

who loves the Forest Garden

Foreword

Ten years ago the first edition of *Forest Gardening* came out, and it has attracted a large readership. That is because it is a book of hope; but even more than that, it is a book of practical instructions for a sustainable future of our own making. Sadly Robert Hart died in 2000, and can no longer enrich our lives with new inspiration. *Forest Gardening* remains perhaps his greatest and most enduring legacy and I am delighted that Green Books is continuing to keep the book in print.

Robert wanted one thing more than anything else: he wanted us to grow forests – food forests. We can plant them all around us – in our communities, on urban wasteland and in our own backyards. By showing us how, he has touched a deep need in many of us, in an age in which the only certainty is change, and thus insecurity. Trees don't race down motorways: they stand still. They are always there in the same place, and the only changes they undergo are those of the seasons, steadily, year after year.

Robert Hart was a rare person. A man utterly convinced of a cause, an imaginative experimenter eloquent in expressing his message and with a stamina second to none. For decades he waged a lonely battle for life, patiently writing books and articles and quietly planting trees on his small farm in Shropshire. Robert created a forest garden which had a profound influence on the way we cultivate our patches of land. It was a garden dedicated to human needs for fruit, nuts, vegetables and plant medicines. But it was at the same time a celebration of the myriad interactions of life; for it was based on profound observations, both intuitive and scientific, of how different life forms interact in order to stimulate and support one another. His forest garden was, at the same time, a revolutionary new creation and a rediscovery of ancient plant knowledge.

For well over twenty years Robert taught the message of the goodness of life. If only we rediscovered the patient art of cultivation we would have little need for the excesses of modern technology. For him life starts and ends with trees. The Earth was once covered with forests. We have stripped away much of its living skin. Today we need to put trees back, allowing them again to root in the living Earth. But there are many people now and we need to plant forests to support our numbers. We need to practice forestry, as well as forest farming or, as this book so eloquently shows, small scale forest gardening.

I have shared Robert's interests for many years. In my travels as a writer and film-maker I have gone out of my way to find forest gardeners, in the tropics and the subtropics and in the temperate regions. Like Robert I have become convinced that cultivating trees is a great art, not of survival, but of living. Nature offered our ancestors an abundance of fruit and nut trees. The people before us – hunter gatherers, forest farmers and orchard cultivators all over the world – used the great imagination and creativity inherent in human nature to select and breed a huge variety of tree crops suitable for most of the climatic conditions on Earth. The pygmies in Africa, the Amerindians and the forest people of Asia rose to the challenge of life in the botanically most diverse regions on Earth by naming, selecting and cultivating a most astonishing variety of food trees, which they improved through deliberate breeding. The forest gardens, or agroforestry systems, in many parts of the tropics are a tribute to their patient art of cultivation. They support some of the highest population densities on Earth and they do so sustainably, both in terms of maintaining soil fertility as well as acceptable climatic conditions. For in hot climates wherever tree cover is maintained the soil is shaded and the temperatures remain moderate. The typical temperature in a mature tropical forest averages around 26°C, but when the forest is removed for cattle ranching, or annual crops, average daytime temperature rises by some 10°C.

Forest gardens are not pristine environments – they are forests modified to suit human needs. But tree gardens, too, are shady, moist and temperate, not quite as cool as the original rainforest, but temperate nevertheless. The great multi-storey food forests of the Chagga on the slopes of Kilimanjaro in Tanzania, for instance, are wonderfully cool but the plains below, now devoid of trees, swelter with heat. The Chagga gardens also happen to support the greatest population densities anywhere in East Africa. In the Amazon I have visited several different types of forest gardens. Some, like the tree farms of the *caboclos* in the flood plains of the river near Belem, have been sustained for centuries. Others have been established quite recently on abandoned cattle ranches by patient farmers,

advised and supported by sympathetic agronomists. There is no doubt in my mind that techniques are available for establishing sustainable forest farming systems on the wastelands of the Amazon even on relatively poor soils. Nature has extraordinary powers of recovery in the face of devastation, but people involved in environmental restoration have to have a profound understanding of the complex interactions that take place in the natural world.

Robert Hart was a man who set out with a determination to help turn wasteland into paradise again. His patient work on his patch of land in Shropshire has led the way for inventing forest farming systems suitable for temperate climatic conditions. Our cool weather does not give us nearly the same range of tree crops that are suitable even for the Mediterranean.

But, as Robert shows, we do have the choice of a far greater range of perennial crops than we are presently aware of. And if plant breeders took up the challenge of working on greater varieties of edible fruits and nuts, within a decade these would make their appearance in our gardens. Robert grew crops from all over the world without any discrimination as to their origins. America, China, Persia, Russia and western Europe can supply crops suitable for temperate climatic conditions. This 'botanical internationalism' transcends the rather limited range of species available here as a result of the genetic extinctions caused by our last ice age. But in the tropics, too, African forest farmers are happy to use South American crops and vice versa. Inventiveness has always been a trait of pioneering farmers. Robert Hart, as this book shows, was a true innovator, who brought the message home into our back gardens that, yes, we can produce an abundance of foods for self-reliance in a rather small space and we can have a great deal of enjoyment doing so. Nature is our origin and our destination, even if technocrats try and persuade us otherwise. But even the body of an engineer or a racing driver, whose glory is his machine, will turn to dust. And that dust is not going to produce a car, but it may feed a tree, one day, if it is allowed to do so.

Herbert Girardet
September 2001

Prologue

The Mini-Forest

I HAVE A MINI-FOREST in my back-garden. It represents a pioneer experiment in restoring a tiny segment of the primaeval Long Forest, which once covered a wide area of the Shropshire Hills bioregion. Like the natural forest, it comprises a wide diversity of plants, occupying seven levels or 'storeys', but, unlike the natural forest, almost all its plants have been carefully chosen to meet human needs. It is, in fact, an attempt to create a model life-support system, which would enable a family or small community to achieve a considerable degree of self-sufficiency in basic necessities throughout the year, while enjoying health-giving exercise in a beautiful, unpolluted and stimulating environment.

My mini-forest is the culmination of many years' study and practice of the system that has come to be known as Agroforestry or Permaculture, and which many people, including myself, believe has a major role to play in the evolution of an 'alternative', holistic world order. A Green World. The world of Gaia.

Agroforestry is the generic term for methods of cultivation in which trees are grown in or at the edge of pastureland or in conjunction with crops. The trees are generally regarded as fulfilling multiple functions: conserving the environment, controlling groundwater, providing shade and shelter for livestock, as well as being sources of timber, fuel, fibres, fodder or food for human consumption. Permaculture (which lays special emphasis on a wide diversity of mainly perennial plants and on landscape design), is a comprehensive form of Agroforestry devised in the early 1970s by Bill Mollison of Australia.

Those who are concerned with the full implications of the ecological crisis which we now face generally agree that urgent steps should be taken to plant many millions of trees. In pondering how this could be achieved, I was haunted by the title of a book by the Australian mining engineer, farmer and landscape designer, P.A. Yeomans: *The City Forest*. It occurred to me that there was no reason why many of the desperately needed new trees should not be fruit-trees planted by the owners of town and surburban gardens, who would gain the bonus of growing nourishing food. If

one could persuade 100,000 Londoners to plant just ten fruit-trees each, that would be a million trees – quite a forest! And if tree-planting programmes were pursued in urban areas around the world, a new worldwide City Forest would arise which would go some way towards compensating for the devastation of the tropical Rainforest.

I had a vision of mini-forests in millions of back-gardens. To demonstrate what I had in mind, with my gardener and partner, Garnet Jones, I converted a small orchard of apples and pears into a Forest Garden, comprising upwards of seventy species and varieties of fruit and nut trees, bushes and climbers as well as herbs and perennial vegetables.

Designed to achieve the utmost economy of space and labour, it is a tiny imitation of the natural forest. Like the forest it is arranged in seven 'storeys', with the original apple and pear trees constituting the 'canopy' and the other plants occupying the lower tiers. Thus the garden has a well-defined vertical dimension as well as horizontal ones. Now that it has been established for several years, I can affirm that it requires minimal maintenance, as the plants – nearly all perennials – largely look after themselves and are very healthy. The main work involved is that of cutting back plants that try to encroach on others. The wide diversity of species ensures that any small invasions of pests never reach epidemic proportions, as they tend to do under monocultural conditions. The large number of aromatic herbs creates a deliciously fragrant atmosphere, and, I am convinced, contributes to the pest-and-disease-resistance of the other plants. As we eat the herbs and perennial vegetables daily in our salads, the garden makes a significant contribution to our diet throughout the growing season, from the first herbs and wild garlic in March to the last apples in November.

Though I worked out the system for myself, I have since discovered that peasants have been creating similar structures for hundreds or even thousands of years in many parts of the world, especially in tropical areas where space is limited by population pressure; among isolated communities living on islands and in oases, remote from centres of supply and distribution, where a degree of self-sufficiency is essential for survival. Some of these Forest Gardens, or 'Homegardens' as they are more commonly called, are found on the sites of ancient civilisations such as those of the Maya and Zapotecs in Mexico and Central America, the Benin in West Africa, the Buddhist kingdom of Sri Lanka and the Hindu kingdom of Java. It must be assumed that those civilisations encouraged a decentralist organisation of society, with numerous self-sustaining communities dedicated to all-round human development, as opposed to the empires which imposed uniformity on their subjects and monocultures on the land.

My own first introduction to the traditional homegarden was in an article on Mexico in *Mother Earth*, the former organ of the Soil Association. 'Mexico is the pattern of ecology,' the author wrote, 'and so, in spite of all her natural shortcomings, can teach us a lot... The *indio's* knowledge and practice of plant associations goes much further than ours, which is by comparison elementary. Their *huertos* (orchards) are mostly round the houses... they are amazing shambles of banana and coffee bushes, orange and lime trees, towered over by mango and zapote and mamey trees, all wild trees of the indigenous forest whose fruits are delicious and wholesome.'

Diversity is the keynote of the forest garden concept, but it must be an ordered diversity, governed by the principles and laws of plant symbiosis; all plants must be compatible with each other. Most forest gardens are designed primarily to meet the basic needs of the cultivators and their families for food, fuel, fibres, timber and other necessities, but some also include a cash component.

The forest garden is the most productive of all forms of land use. Most average about half a hectare in extent and this small area can support a family of up to ten people. It therefore offers the most constructive answer to the population explosion. Java, which has a greater concentration of forest gardens, or *pekarangan*, than anywhere else, is one of the most densely populated rural areas in the world. Yet the landscape does not present an urbanised appearance, as most of the villages are built of local materials and concealed behind dense screens of greenery.

The forest garden is far more than a system for supplying mankind's material needs. It is a way of life and it also supplies people's spiritual needs by its beauty and the wealth of wild life that it attracts.

Chapter One

Towards a Forest Economy

The only basic and comprehensive answer to the colossal harm that our present industrial system is causing to the global environment – harm that could lead to the extermination of all life on earth – is to replace it with a sustainable system, geared largely to the non-polluting, life-enhancing products of the living world.

Bernard Planterose of the Scottish Green Party, in *A Rural Manifesto for the Highlands* (obtainable from Duartbeg, by Scourie, Sutherland IV27 4TJ) has drawn up a fascinating 'greenprint' for restoring the Great Wood of Caledon, which once covered almost the entire Highland region. 'The Second Great Wood of Caledon,' he writes,

> would be no wild and unpopulated place like the first 1000 years and more ago. Whilst sharing several important biological characteristics of the original it would display many fundamental dissimilarities. The main one being its intensive management by Man – nurtured, not destroyed: lived in and by, not on. It would be so well managed in fact as to appear in places almost unmanaged.
>
> It would yield up to its human population a great wealth and diversity of products as well as providing an incomparably more hospitable micro-climate and environment than presently afforded by the bleak and windswept moor.
>
> It would provide a massive new potential of spiritual and aesthetic rewards.
>
> It would fulfill our global responsibilities towards climate stabilisation and the regeneration of a healthy balance of atmospheric gases.
>
> A recreated forest in the Highlands of Scotland would also take its place alongside other current initiatives in the world to reinhabit man-made deserts and would be an expression of solidarity with developing countries of the Third World.
>
> In total it would provide a rich and sustainable resource for more people than ever before living in a new harmony with each other and the land, under new forms of land stewardship which allow for the growth

of more uncompetitive, stable and unexploitative relationships.

The history of Highland ecology shows us that the region has been naturally dominated by a mixed forest since the last Ice-age, that it is only in the last 400 years or so that this dominant vegetation type has been artificially replaced by Man with heath or moor. Ecologists tell us that the present-day natural climax vegetation of the Highlands should be mixed forest over by far the bulk of the land mass.

Direct experience shows us that where open moor and denuded peat can only support a few animals, a few plants and therefore little agriculture, population and employment, a forest can support an abundance of economic activity in proportion to the relative abundance of its biomass and biological diversity.

The Second Great Wood of Caledon would comprise an enormous range of tree and shrub species, providing a correspondingly great range of food (animal and vegetable), fodder, fuel, timber, industrial, craft and even medicinal products. The Wood might be recreated to comprise the best aspects of forest resource usage current in countries such as Norway, Sweden and Switzerland and from the historical past of the first Great Wood of Caledon itself.

The forest-croft would look a little different from the typical croft we see on the Highland mainland at present but would exhibit many qualities that are enshrined in the original crofting practice... It would be intensively managed, serviced by modern appropriate machinery.

Such machinery, Planterose envisages, would include waterwheels, wind-generators, solar panels, biomass digesters, and wave and geothermal devices.

Planterose also foresees that

a wealth of small manufacturing and craft industries would feed off the forest woods. Kitchen utensils, bowls, plates and other household implements would be made from locally cropped woods. Furniture and cabinet-makers would exploit the particular qualities of the woods available in their areas. In the place of today's laminated chipboard and plasterboard there would be good solid Scots pine surfaces and lined walls; warm, insulating and beautiful; not products just a luxury for the wealthy but as the Scandinavians take for granted as part of their forest economy. Other specialist craftsmen would occupy still further economic niches, making musical instruments, boats, toys, tools, charcoal and artworks.

Agroforestry and Permaculture techniques, Planterose considers, would play an important part in the great task of creating a forest economy. He has a vision of 'forest gardens' in which would grow an abundance of the hardy fruit trees and bushes, such as apples, blackcurrants, raspberries and strawberries, which the Scots already know how to grow so well.

The country which already has the most extensive forest economy areas is China. Since 1958, the year of the 'Great Leap Forward', China has pursued, wherever feasible, a policy of integrating forestry with agriculture. Forestry, moreover, is no longer regarded as mainly concerned with timber production, but also includes plants producing fruit, nuts, medicines, oils and many other useful products. Much study has been made of the potentialities of intercropping trees with horticultural crops in compound schemes of an agroforestry nature. The Chinese have long appreciated the special value of multi-purpose plants such as the extraorinarily versatile bamboo. In a post-industrial world economy, the bamboo, which can combine the strength of steel with the adaptability of plastics, would replace many non-renewable resources such as metals and fossil fuels, in the manufacture of a wide range of useful products, from bridges to boats, from cooking-utensils to curtains, from dams to dustpans, from lamps to looms, from mats to musical instruments, from paper to drain-pipes, from scaffolding to shovels.

From the agroforestry point of view, perhaps the world's most advanced country is the Indian state of Kerala, which boasts no fewer than 3½ *million* forest gardens. The state, a long, narrow strip of land between the Western Ghat mountains and the Arabian Sea, stretches down to India's southern tip. Though it is the most densely populated state in India, much of the land is infertile, acid and badly drained. Large parts of the coastline are marshy or comprise mangrove swamps, subject to periodical flooding and tidal waves. But the energetic, cheerful people, with a strong instinct for survival, have found constructive answers to most of their problems. And the leading, comprehensive answer is, in many cases, the tiny family forest garden with a wide diversity of plants and livestock and connections with local industry.

Forest-garden-related industries include rubber-tapping, match-making, cashew-nut processing, pineapple canning, the making of furniture, the building of bullock-carts and catamarans, the manufacture of pandanus mats, oil distillation, basket-making, and the processing of cocoa and of coir-fibres from coconuts. Many families are even self-sufficient in energy, running their own biogas plants, fed from human, animal, vegetable and household wastes. The slurry from these plants, combined with

crop residues and the use of nitrifying leguminous crops, eliminates the need for bought fertilisers. As an example of the extraordinary intensivity of cultivation of some forest gardens, one plot of only 0.12 hectare was found by a study group to have twenty-three young coconut palms, twelve cloves, fifty-six bananas and forty-nine pineapples, with thirty pepper vines trained up its trees. In addition, the smallholder grew fodder for his house-cow. Most gardens throughout the state have canopies of coconuts, towering over a multi-layered structure of different economic plants. The name Kerala means 'Coconutland'.

Residents along the coast make full use of the amazing qualities of the various mangrove trees, which constitute 'forests of the sea'. Mangroves have evolved unique biological structures which enable them to survive conditions which no other plant would tolerate: constant immersion in salt-water and oxygenless, waterlogged mud. In some trees, aerial roots descend from the branches and 'prop' or 'stilt' roots spring out from the trunks, arching down into the mud. These roots pump air into the submerged roots. In other trees the aeration process is performed by vertical roots projecting above the mud. Many mangroves have seeds that float and germinate in salt water; in one tree, the seeds germinate while still attached to the tree. Mangrove wood is extremely heavy and makes the most highly prized firewood. It has an exceptionally high calorific content; mangrove charcoal burns at white heat.

Because of an equitable land distribution system, inaugurated in the 1930s under the influence of Gandhi, most Keralese families have a bit of land of their own. And about half those families have converted their plot, however tiny – many are no bigger than English suburban gardens – into a forest garden, towered over by coconut palms.

Because of these family forest gardens, most people in Kerala are to some extent self-sufficient in the basic necessities, above all food. Therefore, poor as they are, they are far better nourished than most other Indians. They can enjoy the two basic essentials of a nourishing diet: fruit and green leaves. Most Indians never see their national fruit, the mango, vast quantities of which are exported, fresh or in the form of chutney. But the Keralese grow their own mangoes in their own forest gardens, together with some sixty other nourishing food and fodder plants, medicinal herbs and spices.

The Keralese forest gardens are very intensively planted, on several levels, like the natural forest, so that their cultivation, the processing of their products and looking after livestock provide full-time healthy occupations for most members of the families involved, which average 6-8 people.

The way of life they provide is secure, healthy, co-operative, construc-

tive and creative. There is very little need for money; the Keralese work, not primarily for cash, but for the all-round self-fulfilment of themselves and their families. This is true freedom. The family forest garden is the basic unit of society; it provides practical education for the children and happy living, largely free form bureaucratic, political or economic constraints.

Forest garden systems are characteristic of the rainforest belt round the world, from Indonesia to Sri Lanka, to Tanzania, to Nigeria, to Central America. Since time immemorial, people have been entering the rainforests, not to destroy them, but to utilise their vast resources in sustainable ways to satisfy essential human needs. They have gained encyclopaedic knowledge of the properties of rainforest plants and maintained those that were most valuable. Beneath the protective canopies of the tall rainforest trees, they have grown plants that, experience has shown, best meet their personal and economic needs – plants such as cassava and maize, pineapples and bananas. This is the best way to conserve the environment: not to preserve bits of forest and other so-called 'scenic' areas as static museums or parks or recreation areas, but to *develop* them in the best sense of the word: to utilise their vast and wonderful resources in constructive, sustainable ways for the satisfaction of human needs. Science has hardly begun to explore the full potentialities of plant-life. Only about one percent of rainforest plants have been subjected to exhaustive scientific analysis.

It is only in the last twenty years that Western science has begun to take an interest in the tropical forest garden. Until then, if Western administrators or agronomists were aware that such things existed, they dismissed them as haphazard conglomerations of plants. But when the International Council for Research in Agroforestry (ICRAF) was founded by a group of Canadian scientists at Nairobi in 1978, it began to make a close analytical scrutiny of the forest garden and found that, far from being haphazard, it was often a precise, multi-storeyed structure put together by people who had an intimate knowledge of the properties, products and habits of growth of the plants involved.

Chapter Two

Unity and Diversity

Symbiosis – 'living together' or mutual aid – is the basic law of life. Evolution is a holistic process, the development of ever more complex, integrated organisms, involving a spiritual element which ensures that the whole is more than the sum of its parts. The living cell is a miracle of co-ordinated, co-operative activity. One of the first living beings to colonise a barren or devastated landscape, such as a rock-face or an area struck by a volcanic eruption, is a microscopic lichen. This is a symbiotic organism, a tiny green alga enveloped by a fungus. By photosynthesis the alga creates carbohydrates from air and water, using the energy of the sun, and feeds the fungus, which, in return, gives the alga shelter and protection.

Another symbiotic association involving fungi is found very widely among the higher plants, from orchids to trees. This association is a *mycorrhiza*, a mass of fine fungal threads, like the moulds that give character to fine cheeses, which envelops and, in some cases, enters plant roots. The purpose of this beneficial invasion is to supply the plant with phosphorus, an essential nutrient which is a constituent of the nucleic acids that carry genetic information. In return the plant feeds the fungus with sugar and nitrogen. Many familiar woodland fungi, such as the decorative red and white fly agaric – favourite seat for garden gnomes – are involved in this process.

The roots of leguminous plants – members of the pea family – and a few other plants, including alders, also develop associations with soil bacteria which extract nitrogen from the air. The bacteria supply the plants with nitrogen and in turn the plants make their surplus nitrogen available to other plants, their neighbours and successors. The whole process is highly complicated, the bacteria passing through a series of transformations. Starting as minute specks, or cocci, they develop tails like tadpoles, with which they wriggle through the soil in response to the stimulous of a root exudate. A colony is formed near the tip of a root hair, and this excretes a substance which causes the root hair to curl. At the bent tip the bacteria make their way through the cell walls into the root, where they undergo further transformations, from rods back to cocci, and rapidly multiply.

This causes the formation of a root excrescence, or nodule, the 'factory' where the process of nitrogen fixation takes place. The bacteria receive energy for this process and for growth from the plant, which sends out vascular strands from its root; these grow alongside the nodule and pass sugar into it. The nodules involved in nitrogen fixation are pink, and it is an intensely interesting fact that the chemical constitution of the pink pigment is almost identical to that of haemoglobin, the substance which colours the red corpuscles which transport oxygen in the blood of animals and humans.

A problem common to all plants is that of perpetuating their species and bringing forth healthy offspring. Nature, Gaia, has evolved innumerable answers to this problem, some of amazing ingenuity, and many of them involve the co-operation of insects, birds, bats and other animals. The two main aspects of the problem are: how to ensure the strength and adaptability of the young plants through the introduction of 'new blood' from other plants (though some plants are self-fertile), and how to disperse seeds over a wide area, so that they do not suffocate each other and are not starved for light by growing in clumps in their parent's shade.

Sexual reproduction in flowering plants is carried out by pollination, the process by which the male pollen is transported to the stigma, the receptive female surface which is connected to the ovary by the style. While some plants rely on wind or water for pollination, the majority employ various devices to enlist the help of insects. The principal attraction offered is 'nectar', an energising sugar solution which is so located that insects, in striving to reach it, brush their bodies against the pollen-manufacturing anthers. In continuing their search for nectar, the insects carry the pollen on their bodies to other flowers, where it is deposited on the stigmas. Some flowers have highly specialised relationships with particular insects, to such an extent that botanists speak of 'co-evolution' of the two orders of life. Much of the individual beauty of flowers is attributable to their different answers to the problem of attracting specific insects and making use of their particular anatomical features, such as long tongues or long probosces, or particular behaviour patterns. In some cases pollination is an extremely complicated process. The sexual organs of the brazil-nut flower, for instance, are protected by a heavy lid which can only be lifted by an exceptionally strong female bee of one particular species. This bee depends for her existence on the courting activities of the male bee of the same species, which arms himself with scent from a rare orchid in order to make himself sexually desirable. Because human beings have been unable to take advantage of these highly specialised conditions, which are only found in the wild Amazonian rainforest, they have failed

in all their efforts to grow brazil-nuts commercially, and the nuts are still gathered by Indians and rubber-tappers.

Birds and other animals are also instrumental in the dispersal of seeds. For this purpose many plants offer the attraction of a juicy fruit, in which the seed is imbedded. The animal, after eating the fruit, obligingly deposits the seed, complete with a coating of manure, at some point conveniently remote from the mother-plant. Other plants seek the assistance of animals by covering their seeds with sticky hairs, which adhere to the animals' coats.

These examples of co-operation between plants and plants as well as plants and fauna are well established and have been subjected to rigorous scientific research. However there must be many interactions which science so far fails to recognise. Of potentially great economic importance is the widespread traditional lore of plant companionship, which claims that many plants affect their neighbours by stimulating their growth or warding off pests and diseases. Many of the plants involved in this lore are highly aromatic. Science admits that the purpose of plant scents is to attract beneficial insects and deter predators; most people know for instance, that lavender deters clothes-moths. Therefore it seems reasonable to accept that these benefits may be conveyed to the plants' neighbours. It is also admitted that some plants help to fertilise other plants by excreting root-exudates, such as saponin. There can be no doubt, in fact, that there is a continuous interchange of minerals, nutrient fluids and water within the root-sphere.

In the temperate forest, with its deep, rich soils, the root-system burrowing down to the underlying rocks from which it extracts minerals and in which it finds anchorage, is the main power-house of the whole vast organism. Every plant has a different biochemical composition and therefore, by its root-excretions and decay, makes its individual contribution to the fertility of the whole. Living organisms in the topsoil, from bacteria to earthworms, also help to build up fertility while maintaining the soil's circulation system, by which water, oxygen, minerals and radiation are kept constantly flowing. By contrast, in the tropical rainforest, with far shallower soils, most of the fertility build-up takes place on the forest floor and up the stems of plants, where a vast horde of 'decomposers' ensures the almost immediate re-cycling of every waste product. The 'wheel of life', transforming matter into energy, turns far more rapidly under tropical than under temperate conditions. This, however, means that the tropical forest, with all its exuberant vitality, is a far more fragile organism than the temperate one. A temperate forest, once felled, has a vast reservoir of energy in its root-system and rich soils which enables it

to regenerate; but when a tropical forest has been burnt or bulldozed, all its above-ground energy is lost and the thin, infertile soils are rapidly transformed by sun and rain into lifeless concrete.

The forest is not a mere haphazard conglomeration of plants and animals but an enormously complex self-sufficient, self-recycling, self-fertilising and self-watering organism, which takes nothing from outside itself, but confers innumerable benefits on all forms of life. It absorbs the 'greenhouse' gas, carbon dioxide, at a daily rate which has been reckoned to be the equivalent of a 150-foot-high cylinder on the surface of each leaf, and gives out life-giving oxygen. With its architectural framework of trees, it provides niches and 'nurse conditions' for animals of all sizes. The oak, the most ecologically hospitable of all temperate trees, has been described as 'the monarch of the forest' but it does not dominate the other life-forms. Rather, it is the great giver. Its trunk and branches provide niches for birds, small mammals, insects and grubs; its deep roots draw up water and minerals from the subsoil and make them available to other plants, transpiring water through its abundant foliage to make rain. It injects calcium into soils deficient in this vital substance. No wonder the oak was worshipped by the Druids as a symbol and manifestation of the Earth-Mother, Bridya or Gaia, the great giver of all good.

The forest has its own vast circulation system, equivalent to the circulation of blood, lymph and nerve-impulses in the human body. Through this system pass endless streams of water, sap and other fluids, of gases, aromas and magnetic radiations, of forces and information. The force which raises tree-sap high above ground, known as 'vertical pressure differential', depends on the complexity of the tree's cell structure; it is a force which may exceed a quarter of a ton per square-inch, and may operate at speeds in excess of two-thirds of an inch per second. The exchange of information between animals ranges from mating-calls to the dances by which bees indicate sources of nectar to their fellows. Undoubtedly there are innumerable interactions which science has not yet discovered.

Though the forest provides a highly stable environment for its indwelling life for thousands of years – if humans allow it to – this environment is not static. It is continually evolving, with the stronger, coarser plants, especially trees, providing 'nurse conditions', secure niches, within which more complex, more sensitive organisms, may safely develop. This is the law and process of ecological succession, by which Gaia – or her agents – facilitates the emergence of organisms still more fitted to win the battle for survival.

Because, though the forest may convey an impression of all-pervading peace and harmony, and mutual aid is the dominant note, it is also a con-

tinual battleground, a scene of incessant conflicts between predators and prey, parasites and their victims, encroachers and encroachees, disputes over territory. To meet these challenges, living organisms have shown extraordinary ingenuity in developing an amazing range of weapons and devices of defence and offence. These include systems of camouflage and deception, thorns, claws and fangs and the secretion of poisons. In some cases symbiotic mechanisms are employed; for instance, some tropical trees 'employ' armies of ants to protect them against defoliating insects, rewarding their defenders with secure niches in their trunks and a diet of sugary sap.

The organisms which have been most successful in evolving into higher forms of life have been those that have not concentrated on the development of offensive weapons, but have accepted the challenges of antagonism, transmuting them into inner strength, powers of resistance, health, wholeness and self-sufficiency. The organisms which have attained climax status in ecological succession have not merely found ways of overcoming the hazards of antagonists and environment but have utilised them to their own advantage.

The forest is the scene of incessant dynamic happenings, positive and negative, harmonious and competitive: fighting and courtship, mating and feeding, socialising and display. By miracles of natural alchemy, Gaia and her agents have evolved innumerable forms, rhythms, colours, structures, devices, movements, scents, sounds and adaptations, some of extraordinary ingenuity, many of great beauty. One cannot resist the conclusion that creative intelligences of a very high order are at work, continually seeking ever more refined and practical solutions to life's basic problems, but also determined to create beauty for its own sake. One day even human beings, intent on destroying the environment on which they depend and absorbed in their own narrow, greedy aims, will discover that beauty is a biological necessity.

A forest, like other ecosystems and landscapes, may comprise a number of distinct bioregions. A bioregion may be defined as any area, small or large, which has a clearly recognisable identity. Many factors may contribute to this identity: geological structure, soil, climate, types of vegetation, history, culture, 'atmosphere', magnetic and spiritual forces. Some of the world's most notable bioregions can boast well-known 'regional' writers, painters, musicians and craftsmen who, by their art, have interpreted the bioregional 'soul' as manifested by its human inhabitants. Among outstanding examples of links between art and earth are the novels of Hardy and the landscape of 'Wessex', the paintings of Constable and the landscape of the Essex-Suffolk border, and the operas of Janácek

and the Moravian forest. In many parts of Europe, Asia and Latin America, village communities can be recognised by the costumes, songs and dances of their inhabitants, many of them inspired by features of the environment. The patterns and plants of permaculture plots, forest gardens and other forms of land-working should also reflect the character of their bioregions. Those who work them are most likely to benefit if their diets consist largely of the plants that contain the minerals and other nutrients peculiar to local soils, and if they subsist as much as possible on local resources, thereby giving jobs to their neighbours and minimising the polluting effects of mechanical transport. Such people, rooted or 'hefted', to use the Scottish term, to their bioregional soils, enjoy a sense of psychological security, unknown to restless towndwellers.

Both the Highland clan and the native American tribe are examples of bioregional organisms. The relationship of a member of a clan or tribe to her or his *duthus* (the Gaelic term for communal land) has an intense and poignantly beautiful quality. The essence of Amerindian religion lies in the effort to unify soul with soil, the human psyche with the rocks and rivers, the trees and wild-life of the natural environment.

Chapter Three

Health and Wholeness

One of the supreme problems facing humanity today is the vast amount of suffering caused by avoidable disease.

Any living organism, from a plant to a human being, in a state of positive health, has marvellous self-healing and self-adjusting mechanisms. It immediately recognises antagonistic factors, whether poisons, pests or disease-germs, and takes steps to eliminate them. One of its outstanding characteristics is that the fluids, whether blood, sap, lymph or glandular secretions, that constitute a large proportion of its total substance, are in constant free circulation. Therefore one of the main physical causes of all disease is any clogging of the bodily channels that allows a build-up of antagonistic factors. Another characteristic of truly healthy organisms is that they are predominantly alkaline in their make-up. Therefore another major cause of disease is the consumption of foods and beverages that tip the bodily balance towards acidity. It so happens that most human diets throughout the world consist predominantly of cereals and foods and beverages of animal origin, that tend – in the long-run at any rate – to have clogging and/or acidifying effects. Therefore, in order to build up lasting positive health, it is essential to adopt a diet that is eliminative and alkaline. Such a diet should consist of at least seventy percent fresh or sun-dried fruit and green vegetables. Fruit sugars are among the best of all brain foods, energising and rejuvenating the body, while the green pigment chlorophyll has a chemical constitution similar to that of human blood. Bircher-Benner, the pioneer Swiss nutritionist, wrote eloquently about the health-promoting qualities of chlorophyll which, by its unique ability to create carbohydrates by harnessing the power of the sun, is the basis of all physical life. It contains a large number of vitamins and – contrary to general belief – a valuable protein. These make it an efficient creator of red blood-cells, normaliser of blood pressure and healer of wounds. One of Bircher-Benner's maxims was: 'Never let a day pass without eating green leaves.'

The 'forest garden diet' comprises the widest possible variety of fresh fruit and greenery, derived not only from vegetables but also from culti-

vated and wild herbs. It thus approximates to the 'sallets' that were regularly consumed in 17th century England, the age of the great herbalists. Many visitors learn from experience that this diet is not only satisfying but can be surprisingly delicious. The strong flavours of many herbs, and even 'weeds', lose their harshness when chopped up with other foods and served with a drop of fruit juice and/or tofu mayonnaise. Tasting sessions are a popular feature of visits to Highwood Hill. One of the garden's specialities is experimenting with uncommon food-plants.

My whole life has been a struggle against ill-health in my family and myself, and for me the forest garden has been part of the culmination of that struggle.

It has never been merely a negative struggle, against weakness, fatigue, nervous debility and pain, but from childhood I have sought to transcend my own and my family's problems by working out a science of positive health, a holistic way of life, that might in time benefit many others as well as ourselves.

The essence of life should be continuous creativity: in working out creative and comprehensive solutions to one's problems, one rises above them. They become smaller, less tormentingly insistent, until, perhaps, in time, one realises they have just faded away.

One way in which I have sought to rise above my problems has been – literally – by climbing hills and mountains. During my last holiday abroad I explored a remote Swiss valley from end to end, and there I first encountered the peasant ethos of proud self-sufficiency. During one phenomenally hot summer, the glacier at the head of the valley had partially melted, causing a disastrous flood. A subscription had been organised throughout the country to help the stricken inhabitants, but when the money reached the town-hall of the valley's principal village, the people asked that it should be given to others 'less able to help themselves.'

In his study of Chinese yoga, *The Secret of the Golden Flower*, the great Swiss psychologist C.G. Jung wrote:

> I always worked with the temperamental conviction that in the last analysis there are no insoluble problems, and experience has so far justified me in that I have often seen individuals who simply outgrew a problem which had destroyed others. This 'outgrowing' revealed itself on further experience to be the raising of the level of consciousness. Some higher or wider interest arose on the person's horizon, and through this widening of his view, the insoluble problem lost its urgency. It was not solved logically on its own terms, but faded out in contrast to a new and stronger life-tendency. It was not repressed and made uncon-

> scious, but merely appeared in a different light, and so became different itself. What, on a lower level, had led to the wildest conflicts and to emotions full of panic, viewed from the higher level of the personality, now seemed like a storm in the valley seen from a high mountain top. This does not mean that the thunderstorm is robbed of its reality; it means that, instead of being in it, one is now above it. (English translation by Cary F. Baynes, Kegan, Paul, London, 1945, p 88.)

Having thus transcended the problem, one is able to transmute its negative elements into something wholly positive. This fundamental psychological process is the secret of all great art. Thus Beethoven was able to transmute the traumatic discovery that he was becoming deaf into the Eroica symphony, that crucial landmark in the history of music. Musicologists have argued about the identity of the 'hero' whom the symphony was 'about', but Beethoven himself was the true hero: a Beethoven who had learnt to transcend his personal problem by identifying himself with humankind's struggle for freedom.

In taking over Highwood Hill, I resolved that the creative enterprise of building up a small organic farm was to be a major comprehensive and constructive answer to my own and my family's health problems. It was to be the alchemical *opus*, in the course of which the leaden burdens of our physical and mental shackles were to be transmuted into the gold of health and beauty.

* * *

What is a medicinal herb?

It is a plant containing 'secondary' products that play no identifiable part in the metabolism of the plant itself, but seem to be intended by Nature – by Gaia – for the healing of animals, of human beings – and possibly in some cases, of other plants. These 'secondary' products are highly complex chemicals. They include:

alkaloids, which are known to affect the human nervous system;
anthraquinones, which are purgatives and also dyes;
bitter principles, which stimulate the secretion of digestive juices;
cardiac glycosydes, which can increase the power of the heart-beat;
essential oils, which are aromatic, antiseptic and strengthen the immune system;
flavones and flavonoids, which stimulate and strengthen the circulatory system;
mucilages, which soothe the whole system and reduce inflammation;

phenolic compounds, which are antiseptic and reduce pain;
saponins, soap-like substances, which reduce inflammation and are used as purgatives; and
tannins, which have an astringent effect and aid the sealing of wounds.

Despite all the scientific research that has gone into them – research that has led to the production of a number of well-known drugs – herbs still have a mysterious fascination for me. I have been growing, studying and using them since my first days at Highwood Hill. They can be divided into two categories: those that, in their natural state, are woodland plants, and therefore tolerate shade, and those that naturally grow on heaths or in grassland and therefore require full sunlight.

Among shade-tolerant herbs and perennial vegetables growing in the forest garden are ten varieties of mint, including eau-de-cologne mint, which has the most delicious scent of any plant I know; two varieties of balm, with its lemony scent and taste, a plant much valued by herbalists for psychological effects in relieving anxiety and raising the spirits; three varieties of sorrel, another plant with lemon-flavoured leaves, an ingredient both of traditional salads and of the French *soupe à l'oseille*; tansy, a vigorous plant with gay, golden flowers, a pungent odour and an acrid taste; lady's mantle, a ground-cover plant with frilly leaves, esteemed by the Arabs and throughout Europe for its effectiveness in treating feminine ailments; three types of celery: wild celery, sweet cicely and lovage, a giant herb that may reach heights exceeding three metres; comfrey, formerly known in country areas as 'knitbone', another extremely vigorous plant containing a potent mucilage which can aid the healing of fractures; Good King Henry, known in Eastern England as 'Lincolnshire asparagus', a member of a very interesting family of dual-purpose plants, which also includes the Peruvian quinoa, and which combines the virtues of vegetables and cereals; and Rosa rugosa, a tall and vigorous member of what is probably the most loved of all plant genera, prized equally by mediaeval herbalists and modern nutritionists for the high vitamin C content of its large, tomato-shaped hips, and whose crimson flowers inject a startling note of vivid colour into the prevailing greenery.

Among sun-loving herbs are several species of *Artemisia*, including wormwood and southernwood, plants with pungent odours and extremely acrid tastes, which have long been valued by herbalists for the treatment of digestive troubles; rue with striking blue foliage and sickly sweet smell; marjoram with its florets of subtle purplish pink; fennel with its gold umbellifer flowers set off by feathery 'bronze' foliage; Biblical hyssop with purple, strongly aromatic flowers, which benefits the eyes

and helps to regulate the circulation of the blood; borage, with its heavenly blue flowers, beloved of bees, which is said to instil courage into the human heart; catnip, another herb with blueish flowers beloved of bees – and of cats, who find it literally intoxicating; rosemary, the favourite herb of Juliette de Bairacli Levy, who describes it as 'a supreme heart tonic'; an uncommon purple broom, used by Spanish gypsies for making perfume; lavender, another scent-making plant, whose powerful aroma wards off insect pests and benefits the nerves; goat's rue, a tall herb with white pea-flowers capable of promoting milk-secretion in all mammals, and soapwort, a plant with flowers of pinkish white, notable for its store of saponin, which not only brings medicinal benefits to the skin but is also a detergent, still used for washing delicate fabrics, such as old tapestries. One of the choicest spots in the whole garden is a bed of soapwort, hyssop and southernwood, framed by a pear, a crabapple and two buddleias, beloved of butterflies, with, as its backdrop, a distant view of the wooded slope of Wenlock Edge.

Of all the drugs commonly prescribed by Western medicine, at least fifty per cent contain ingredients of plant origin. Moreover research is continually in progress to analyse fresh plants for their healing potential. Modern science therefore fully endorses the traditional view, going back to ancient Egypt and probably to prehistoric times, that the plant world is a vast repository of precise and effective remedies for most of the ills of humankind. Where herbalists disagree with conventional medicine is in maintaining that safer and, in the long run, more effective results can be obtained from consuming plants whole rather then in the form of extracts. Plants are complex and intricately balanced organisms containing a wide diversity of hormones, enzymes and other vital substances, whose negative effects are neutralised by positive ones. If, therefore, a plant extract is consumed alone, there tend to be undesirable side-effects which may lead to complications.

For quick results in emergencies, antibiotics may sometimes be necessary. The practice of herbalism is essentially part of a positive, holistic, health-building process, whose results tend to be slower and less sensational than those of orthodox medicine, but which tend to have a more lasting effect on overall health. Human beings are what they eat and drink – and think. Our systems are made of the foods and beverages that we consume and the thoughts that we allow into our minds. Moreover, there is a constant interaction between physical and mental factors: they affect each other. By what we eat and think we help to control the construction of our most vital organs, including the brain, heart, liver, glands, nervous system and eyes. An engineer building an elaborate and sensitive machine

such as a computer or space-craft, takes the utmost care to select the most appropriate materials, whether metals, timber or plastics, to ensure strength and endurance, resilience and reliability. If, therefore, we wish to obtain and maintain lasting health in all our organs – more intricate and complex than those of any man-made machine – and if we wish to avoid chronic illness, there can be no doubt that we must include in our diets a wide diversity of the plant-materials that experience has shown have the most beneficial effects on the different components of our systems.

In the sixteenth and seventeenth centuries, when England experienced a notable flowering of genius in several spheres – literature, music, science, religion, philosophy, medicine and herbalism – it is significant that a standard dish was a 'sallet' or 'salmagundy' comprising a wide variety of ingredients, including herbs, whose healing and prophylactic effects were well understood. Intelligent, life-loving people practised the advice of the contemporary Swiss philosopher and physician, Paracelsus: 'Make food your medicine and medicine your food.'

In our own century, another Swiss physician, the pioneer nutritionist Bircher-Benner, postulated that the single most important factor in a health-promoting diet was the green leaf. This is because the green coloration is due to one of the most wonderful substances in the world, chlorophyll. This has the unique ability to use the energy of the sun to transform the products of soil, air and water into living matter, and is therefore the basis of all physical life. It is a remarkable fact that the biochemical composition of chlorophyll is almost identical to that of human blood, the wholesomeness – wholeness – and free circulation of which are a basic necessity for positive health and vitality.

The consumption of chlorophyll-rich green plants, especially when eaten raw and fresh from the soil, has been proved to confer many benefits on the human system. It promotes the formation of red blood-cells, improves circulation, normalises blood-pressure, heals wounds and even helps to protect the body against airborne pollution and radiation. Moreover, perennial green plants, such as many herbs, are particularly rich in minerals, which their deep roots extract from the subsoil.

Among these essential minerals is iron, one of the main constituents of the red blood cells, where one of its functions is to form an association with oxygen, which we breathe in from the air with our lungs. Oxygen is one of the six essential elements of living matter, the others being carbon, hydrogen, nitrogen, sulphur and phosphorus. The function of oxygen is purifying and transformative. With the aid of iron, it courses through the blood and is carried to every part of the human body, burning up blood-sugar and waste products and converting them into energy. Oxygen is

therefore the main fuel of the body-machine. When it is deficient, owing to a shortage of iron in the diet, then anaemia sets in, characterised by listlessness, fatigue, headaches, bad memory and low blood-pressure. An abundance of dietary iron is therefore essential for nursing mothers and growing children. Iron also helps to control the circulation of the blood, acting as a built-in thermostat, keeping us relatively warm in cold weather and cool in hot weather. It gives us vitality, strength and endurance. Among the best sources of iron are whole cereals (not refined cereals), apples, pears, plums, grapes, apricots, bananas, raisins, dates, figs, nuts, carrots, onions, turnips, lentils, honey, watercress, spinach and other green vegetables.

Another basic necessity for healthy blood is an abundance of Vitamin C, the best source of which is fresh, raw fruit and vegetables. It had long been known that sailors, deprived of fresh fruit and vegetables during long voyages, tended to suffer from scurvy, a disease characterised by anaemia, spontaneous bleeding and slow healing of wounds, but Captain Cook was the first to realise the cause and the best way of preventing it. He therefore ordered that his ships should be provided with abundant supplies of oranges and limes, and, under his influence, the practice was started of including lime-juice in the rations of the Royal Navy, a practice which led to British people being known in America as 'Limeys'. One of the most important functions of Vitamin C is to strengthen the blood's wonderful armoury of protective devices, the phagocytes and antibodies which destroy invading disease germs. Bircher-Benner stated that, for optimum health and lasting youthfulness, the body should be 'saturated' with Vitamin C, but this can only be done by consuming large quantities of fresh, raw fruit and vegetables every day. Vitamin C is the most vulnerable of all the vitamins; it is destroyed by unnatural chemical substances and also by cooking and storage; moreover, unlike other vitamins, it is not stored or manufactured within the body's tissues. This is why we need daily supplies.

Another vitamin that is essential for healthy blood is Vitamin E. It is vital for the free circulation of the blood: it dissolves blood clots, and therefore helps to prevent thrombosis, that major killer in our Western civilisation. It is also beneficial in the treatment of high blood pressure, varicose veins and heart trouble. It is the major fertility vitamin, found in the seeds of vegetables and cereals, above all wheat-germ, and in oils derived from seeds, such as groundnut oil and sunflower oil, and also in green leaves. It is the most important vitamin for nursing mothers.

Another mineral which is essential for good blood circulation, by ensuring that the heart functions efficiently in its work as pump, is iodine.

This is one of the main foods of the thyroid gland, that tiny gland in our throats which exerts a key role in controlling many of our body's vital functions, including metabolism, energy production, growth, reproduction, nerve currents in our muscles and the growth of skin and hair. It is interesting to note that that very vital race, the Japanese, ensure a steady supply of iodine and other minerals in their diets by consuming large quantities of seaweed, the constituents of which are almost identical to human blood; in fact, Japanese doctors often use an extract of seaweed as substitute for blood plasma. The Japanese have thousands of seaweed farms, many of them employing girl skin-divers who harvest the weed under the waves. The rest of us are largely dependent on fruit, vegetables and cereals which extract iodine from the soil. This, however, is an unreliable source, as some soils, especially in limestone areas such as Derbyshire and parts of Switzerland, are iodine-deficient. People in such areas are prone to goitre, an enlargement of the thyroid caused by lack of iodine. Goitre has been largely eradicated in Switzerland by the use of iodised table-salt. Apart from seafood, good sources of iodine are garlic, onions, soya beans, pineapple, pears, strawberries, tomatoes, celery, lettuce, oats, spinach, beet and wheat. If iodine-deficiency is suspected kelp tablets seem to be quite effective. Another way of ensuring an adequacy of iodine in the diet is by applying seaweed fertilisers and seaweed foliar sprays to one's own fruit, vegetables and herbs, as I do myself.

Among minerals which are essential to the brain and nerves, the most important is phosphorus, of which the best sources are whole cereals, nuts and most vegetables, especially peas and beans. A diet that is deficient in these vital ingredients can affect the intelligence – and also the character.

Another mineral essential to the nervous system is calcium. It helps the transportation of nerve impulses and promotes the sensitivity of the nervous system to stimulation; shortage of calcium leads to tension, irritability and cramp. Calcium, phosphorus and potassium are the three most important minerals concerned with building the body of the growing child. Calcium is a vital constituent of bones and teeth.

The motive power for many of the body's complicated mechanisms is provided by the enzymes: tiny, highly specialised chemical catalysts which exist in every cell. These are above all transformers, and they act by causing fermentation. They perform the extraordinary feat of transforming the food we eat into entirely different substances, such as blood, bones, nerves, hair and finger-nails – a feat which the greatest chemical genius is incapable of duplicating. They are also at the heart of every chemical action in the body, including those involved in growth, nerve impulses and the movements of muscles. While some enzymes are manufactured by the

body, most are dependent on minerals in the food we eat, including iron, potassium, manganese, copper and zinc. The best sources of these and other minerals are raw fruit, vegetables, nuts, sun-dried fruits and wholemeal cereals. We also imbibe complete enzymes from plant cells. It is an interesting fact that many plant-foods contain the precise enzymes that are necessary to digest them.

Consumption of refined sugar, sweets and soft drinks tends to neutralise the effects of calcium; this is why so many children today suffer from tooth decay. The best source of calcium, both for children and adults, is generally considered to be milk, but some nutritionists have reservations about milk as an ideal food, except for mother's milk in the case of a baby. Milk is a highly specialised food (it is a food, not a beverage, as it coagulates in the process of digestion), designed by nature to promote the development of young mammals. Each species has a different milk. Human milk has five times more brain-forming substances than cows' milk, which is adapted to the needs of a bulky, slow-moving and not very intelligent animal. Moreover, milk, milk products and all other forms of animal fat cause, in the adult, a gradual clogging of the system with cholesterol, which eventually leads to arthritis, heart-disease and other chronic illnesses characteristic of Western civilisation. It is significant that the Chinese, Japanese and Koreans drink very little cows' milk and eat very little meat because they are short of agricultural land and can't afford to waste it by putting it down to grass, when it can be used so much more productively for growing crops. Instead, they eat enormous quantities of soya beans and soya products and drink soya milk. Soya beans are a good source of calcium, as are citrus fruits, figs, whole grains and nuts. Soya beans also provide what is probably the best of all proteins, as they are the only foodstuffs known that contain the full complement of twenty-two amino acids, of which complete proteins consist.

Proteins and water are two primary substances of which our bodies are made, so a good supply of proteins is essential for growing children. Adults need a smaller proportion of proteins in their diet – just sufficient to make up for the continuous wearing process in their tissues. Nutritionists consider that it is best for adults to avoid overburdening their systems with excessive proteins, if they wish to retain their fitness, energy and youthfulness. Nutritionists of the Bircher-Benner school strongly oppose the notion that only animal proteins – meat, cheese etc – are 'first-class', while vegetable proteins – such as beans, lentils, nuts, cereals, mushrooms and green leaves – are 'second-class'. In fact, they believe the reverse to be the case. The green leaf contains a protein of particularly high value.

The cells of the stomach are strengthened by Vitamin A, which is also essential for the strength and health of other vital bodily organs, especially the eyes, skin, bones, teeth, nerves and all mucous membranes. The adrenal glands which pump energy-giving hormones into the system in emergencies need an abundant supply of Vitamin A and also of Vitamin C, if they are to function efficiently and not let us down at times of crisis. Vitamin A also affects the breathing; if it is in short supply, we are liable to complaints affecting the lungs and bronchial tubes. The best of all sources of Vitamin A is raw carrots. During the Second World War pilots of night-flying aircraft were given raw carrots to strengthen their eyesight. Other good sources are apricots, rose-hips, peaches, oranges, pineapples, tomatoes, green vegetables, whole cereals and vegetable oils.

Another source of energy in emergencies is glycogen, or animal starch, which is stored as granules in all the tissues, but especially in the muscles and liver. The glycogen in the liver is the body's principal energy reserve. It is mobilised when needed by conversion into glucose, which enters the bloodstream, giving us the 'shot in the arm' which we need in order to face up to difficulty or danger. The best source of glycogen is an abundant supply of vegetable carbohydrates, those basic substances manufactured by green plants with the aid of the sun's energy in the course of photosynthesis.

The only comparable process to photosynthesis in the case of human beings is the manufacture of Vitamin D by the effect of ultra-violet rays from the sun on fat in the skin. Vitamin D exerts a major influence on the growth and hardening of bones and teeth. A deficiency in childhood leads to rickets and tooth decay. As the teeth are the hardest bones in the body, tooth decay may be a warning of more serious disorders affecting the more delicate internal organs, and, apart from visits to the dentist, measures should be taken to build up general health. These should include taking every opportunity to enable the child to enjoy the effect of sun on his skin, thus accumulating valuable stores of Vitamin D. The process of manufacturing Vitamin D in the skin is assisted by green plants, cereal germ and yeast. The principal food sources of Vitamin D are generally assumed to be milk and eggs, but it is also found in sunflower oil, peanuts and mushrooms.

When I remark that we live on a mainly raw vegan diet with no animal products and only one gluten cereal, rye, people exclaim, 'What on earth do you eat?' In fact we enjoy an extremely varied diet. Our daily salads comprise the widest possible diversity of fruit, including dried fruit, vegetables, herbs, nuts and fungi, including mushrooms and yeast extracts, as well as vegetable oils. In addition I cook, minimally, roots, pulses and cere-

als as well as vegetables, such as cauliflowers, which are somewhat indigestible if eaten raw. I avoid the gluten cereals, wheat, barley and oats, because gluten, the protein that these cereals contain, as its name implies, is a gluey substance that tends to clog the system. Rye has the least gluten of any of the gluten cereals and contains strengthening factors which make it the favoured cereal of the hardy people of northern Europe. We eat it in the form of Ryvita and rye-bread. The other cereals we eat are rice, millet, buckwheat, sesame and quinoa.

Anyone who has any doubts as to the enormous variety of foods that can be included in the daily salad should peruse Joy Larkcom's fascinating and beautifully illustrated book *The Salad Garden*. To her the creation of a salad is a work of art, from the sowing of seeds in carefully worked-out associations, to giving aesthetic effects to the concoctions of dishes, ornamented with flowers and variegated leaves. She doesn't despise wild plants, even 'weeds', some of which contain robust nutritional factors that are absent from more delicate cultivated plants. The best way to deal with coarse leaves, such as those of nettles and comfrey, I have found, is to boil up a saucepanful of potatoes, and add the leaves when the potatoes are just cooked. Cutting the leaves up with the potatoes is sufficient to remove the roughness and sting, and the result is a surprisingly tasty 'bubble-and-squeak'.

Chapter Four

Personal Pilgrimage

My own pilgrimage which led to the realisation of the forest garden concept started in a rather primitive wooden bungalow raised on stilts above one of the smallest of the Norfolk Broads. It could be regarded as a descendant of the prehistoric Swiss lakeside dwellings. Running beneath its entire length, except for the verandah, was the boathouse, and when some of the supporting piles were found to be rotten and needed renewing, a giant Norfolk wherry was piloted into the boathouse by a local giant, Nat Bircham the odd-job-man, and the whole bungalow was raised while the work of sinking new piles went ahead. My mother laid out the garden on Japanese lines, with purple *Iris kaempferi* surrounding a sculptured figure known as the Alder Girl. A hump-backed Japanese wooden bridge made by a local craftsman linked the garden to a small marshy wood, known in Norfolk as a 'carr', with a path leading to a summerhouse, also on stilts, overlooking the large neighbouring broad. The garden, wood, broads and river teemed with wildlife: wild yellow iris, marsh orchids, flowering rushes, electric blue dragonflies, swallowtail butterflies, otters, herons, great crested grebes and bitterns, which kept us awake at night with their 'booming'. In the winter the garden was usually under floodwater and I remember seeing my mother's beloved crimson roses blooming beneath the ice. One of the principal local industries was reed-cutting, and our bungalow was roofed with reed-thatch. For the first time in my life I felt I was becoming an initiated member of a regional ecology.

In fact my first introduction to the study of ecology and organic growing came from reading a book by a member of an old Norfolk family, H. J. Massingham, the country writer whose prolific works are now enjoying a revival of interest. Following a near-fatal accident which led to his losing a leg and the use of an arm, he found solace during the Second World War by building up a garden behind his cottage in North Buckinghamshire, and by dedicating himself to self-sufficiency and wholeness of living. Described in his masterpiece *This Plot of Earth*, he regarded the garden as a model of a new civilised order, freed from the aberrations

Fig. 1 Japanese bridge leading to alder carr

which lead to war and the destruction of the environment. Covering just one acre, it was an ordered jungle comprising a bewildering variety of fruit trees and bushes, vegetables, herbs and even two cereals, oats and maize, all interspersed with flowers and organically cultivated. Enjoying meals of home-grown produce throughout the year and mentally nourished by the ever-changing beauty of his environment, Massingham cured himself of chronic ailments, such as catarrh, which had formerly afflicted him, and found himself able to do twice the amount of intellectual labour he had done before his accident.

Norfolk was the first stage in the long process by which I, a Londoner born and bred, have gradually sunk ever deeper roots in the English countryside.

My forbears originated in beautiful and historic rural areas but all, for various reasons, converged on London. My father was of Lowland Scots and Spanish Basque descent. Robert Hart the First, my great-grandfather, was a steel engraver, a skilled craftsman, who came from Melrose in the well wooded Tweed valley, one of the cradles of Celtic Christianity, from which missionaries carried the Christian faith through much of Saxon England before the arrival of Augustine. I have one of Robert's finest engravings: a portrait of John Evelyn, the 'Seventeenth Century St. Barbe-Baker', whose great work *Silva* led to the planting of millions of trees in an England denuded by the 'great bravery of building' and ship-building during the Tudor and early Stuart periods. Robert had a passion for history and, in particular, for the story of humankind's agelong struggle for

freedom. He named his two sons George Washington and John Hampden and his three daughters after ladies who had all met violent deaths in the cause of freedom: Boadicea, Lucretia and Virginia; the last being a Roman plebeian maiden who was slain by her father to prevent her from being raped by a patrician.

On the Basque side my ancestor Nicasio María Serafín de Jauralde was a freedom fighter himself. The son of a Pyrenean landowner, he became caught up in the siege of Saragossa during the Peninsular War and later took part in an abortive revolution against a reactionary king, Ferdinand VII, to be taken prisoner by the king's French allies. After escaping from a French prison camp, Nicasio made his way to London, where he maintained himself by teaching the guitar – then a fashionable instrument – and married one of his pupils. On the accession of a more liberal monarch, he returned to Spain, only to be caught up in a civil war and again forced to flee. His wife carried their baby on mule-back across the Pyrenees. Eventually he settled in London as head of a Spanish financial delegation, to be succeeded by his son, another Nicasio, who served in the Spanish government service for the phenomenal period of seventy-two years, retiring at the age of eighty-eight.

Among my mother's ancestors were a family named Lacon, who were first recorded as living in a village of the same name in North Shropshire in the 12th century. In the Tudor and Stuart periods they seem to have been great foresters as one of their estates, Kinlet, close to Wyre Forest, was once famous for its trees, and another, Willey, still has some magnificent trees which may well be 400 years old, as well as a remnant of the royal forest of Shirlett, part of the primaeval woodland which once covered most of South Shropshire. In the tower of Willey Old Hall is a priest's hole leading to a vast underground vault which might well have housed the whole local population of Roman Catholics at times of religious per-

Fig. 2 Swallowtail butterfly

secution, as the Lacons were ardent Catholics. Another of my mother's ancestors was Thomas Pear of Spalding, Lincolnshire, one of the engineers who drained the Fens.

After leaving Norfolk we spent over two years house-hunting from bases in Sussex and the Hardy country. The most attractive of our temporary homes was an old mill-house in a village between Sherborne and the great Iron Age hill-fort of Cadbury Castle, reputed to be Arthur's Camelot. I found that Cadbury Castle, among the first of many hill-forts around which I have since roamed, exuded an overwhelming 'atmosphere'. One of the essential factors in the process of sinking spiritual roots in the countryside is the development of sensitivity to the spirit of place. I would define 'atmosphere' as a sense of communion with the human beings whose emotions have left an imprint on the area where they lived and loved and suffered. In many historical sites I have felt a warm sense of kinship with the men and women who strove to survive in the frontier conditions of Celtic Britain and Saxon England. I felt an intense desire to reconstruct their way of life – at any rate in my mind – and it occurred to me that we in the twentieth century have much to learn from them. Above all, the tight-knit comradeship of men and women living in forest-clearings, their villages stockaded to keep out wild animals and human marauders, was far preferable to the 'couldn't-care-less' individualism which prevails in our urban and suburban non-communities.

Studying landscape archaeology, I learned to recognise indications of the structures both of the Celtic civilisation which was presided over by the *acropolis* of the hill-fort and of the Saxon village community. In both ways of life, self-sufficiency was the keynote. Trade routes, following leylines, packhorse tracks or ridgeways, were practically the only contact with the outside world, bringing the few necessities, such as salt, which the villagers could not produce themselves. The later Saxon village community, when situated in an undulating area, was a three-tier structure with summer grazings on the hill-tops, open cornfields on the slopes and meadows for hay, calf-rearing and winter keep in the valleys. The most important building in most villages after the church was the mill. This could be either a windmill or a watermill. Most often it was used for grinding corn, but, in more recent times, it might be a 'waulking' mill for fulling cloth, or a sawmill, or it might be used to drive a machine such as a trip-hammer. A watermill often involved an elaborate system of leats, weirs and ponds, the maintenance of which was the responsibility of the whole village. These waterworks played an important part in the control of flooding.

An indispensable part of the village community system was the patch of wild woodland, which was carefully maintained on a sustainable basis

for the supply of timber and fuel, the trees being coppiced or pollarded. The wood, hedgerows and wastelands were also valued for their wild foods and medicines. It is obvious that our forbears of the Saxon and mediaeval periods had an encyclopaedic knowledge of the properties of wild plants, comparable to that of the forest and desert Indians of the more remote parts of the Americas today. Remnants of this knowledge can be found in such books as *Food for Free* and *Plants with a Purpose* by Richard Mabey, as well as in many modern herbals. This vast fund of traditional knowledge bore fruit in the works of the famous school of English herbalists in Tudor and Stuart times, from William Turner, the 'Father of English Botany', to Culpeper and Coles.

While staying in the Sussex village of Bosham near Chichester I heard a series of BBC talks by John Seymour, the well-known writer and organic pioneer, known as the 'Guru of Self-Sufficiency', in which he described how he and his wife Sally had carved a miniature organic farm out of five acres of remote Suffolk heathland. I was badly bitten by the self-sufficiency bug. Lifting up my eyes to the South Downs, I resolved to look for a small upland farm where I could strive to achieve a degree of self-sufficiency myself. After extensive searching I found what I was looking for: a beautiful old red sandstone farmhouse in a secluded West Somerset backwater on the lower slopes of the Brendon Hills west of Lydeard St. Lawrence.

The area had been eloquently described by H.J. Massingham in *Wisdom of the Fields* after his stay on one of the small family farms characteristic of the area during the momentous months following D-Day 1944. For Massingham the contrast between the carnage in France and the peace of this remote corner of rural England was overwhelming. For him this peace was not a mere absence of strife in an idyllic landscape but a positive sense of secure and harmonious living, rooted in the earth and maintained by all-round human development and the co-operative ethos – co-operation not only between human beings but also between people and nature. 'This is a home for the family farmer,' he wrote. 'Of such a life as he leads among the tossing foothills self-sufficiency is the structure and neighbourliness the buttress... The interchange of voluntary labour occurs at the peak periods throughout the year – above all at harvest time.'

For Massingham, the special significance of the Lydeard St Lawrence experience lay in the fact that he saw in its farmers the spiritual descendants of the yeomen who, in the seventeenth and eighteenth centuries, had been regarded as the backbone of England: sturdy, freedom-loving and hard-working with wives as industrious as themselves, skilled in the arts

and crafts of self-sufficiency. The archetypal yeoman was William Cobbett who, at the beginning of the nineteenth century, waged a lone rearguard action in his writings and speeches as Member of Parliament against the forces let loose by the Industrial Revolution, which he saw striking at the root of the ecological agricultural system and way of life.

My own small farm was approached by a steep, narrow lane with high banks on both sides, so that in summertime, when the hedges on top of the banks were in full growth, it practically became a tunnel. The farm comprised an almost precipitous pasture field of five acres, from the top of which one could gain a distant view of the Bristol Channel, and three acres of orchards and soft fruit. Having let the field to a local farmer for grazing, I concentrated on the fruit as well as on sowing vegetables. Intent on following the organic system, one of my first actions was to build seventeen compost heaps at strategic points, the largest of which I named 'Dungery Beacon', after Dunkery Beacon, the highest point of nearby Exmoor.

My main cash crop was blackcurrants, which I manured with seaweed from Dunster Beach. After harvesting them I took the currants on my trailer across the Quantocks to a jam factory at Bridgwater. Some of the bushes had been interplanted with plums, which I learned was a traditional association in the South-West, as both sets of plants were believed to encourage each others' growth and neutralise each others' pests and diseases. This was my first introduction to the lore and science of plant symbiosis.

Throughout my career on the land, I have been fortunate in my contacts with old-fashioned country workers, from whom I have learnt more about the true arts of growing plants and tending livestock than I could ever have learnt at a horticultural or agricultural college. As some of the old craftsmen knew, the best way to learn skills is simply to watch a skilled and experienced craftsman at work and imbibe the *feel* of his actions. So when my gardener Mr White earthed up two rows of cauliflowers with a mattock – a tool which is a Somerset speciality and known locally as a 'biskey' – I felt I was being initiated into a new realm of rhythm and of plant care. The mattock is perhaps the most ancient of all tools, going back to the Stone Age, and, though it is largely obsolete in Britain, it is still used throughout Africa. When wielded by an experienced hand it becomes an invaluable multi-purpose tool for breaking up stiff ground, planting, hoeing, weeding, earthing-up and, as I learned later, for irrigating.

My tutor in bee-keeping, Mr Rowe, was an indomitably cheerful little man who drove a horse-drawn cart and led an arduous life cultivating

Fig. 3 The mattock, an ancient multi-purpose tool

three and a half acres of precipitous, terraced hillside, every square inch of which was covered with a wide variety of fruit, vegetables and fodder-crops, providing sustenance for himself, his wife, a flock of goats and poultry. I couldn't have had a better introduction to traditional self-sufficiency.

Somerset was a brief interlude in my quest for self-sufficiency. The farmhouse proved too large and inconvenient for my mother to manage, so regretfully we sold Dean's Farm and resumed our searches for a more suitable home. One day we found ourselves looking down on a small stone cottage nestling in a fold of Wenlock Edge, the heavily wooded limestone ridge which runs for some 20 miles across South Shropshire, and we felt we had reached our final destination. I had been drawn towards the quiet and – in places – wild Welsh border countryside of Shropshire, with its strong Celtic atmosphere, ever since reading the poems of A E Housman and the novels of Mary Webb shortly after leaving school. I can't help feeling also that my Lacon ancestors had exerted some sort of magnetic pull. They had once been a potent force in the very neighbourhood where we decided to settle, owning an estate called Wilderhope in Hopedale and a reputedly haunted, moated manor-house called Thonglands in Corvedale, both a few miles from our new home.

The cottage occupies what is obviously a very ancient inhabited site. It stands by a spring of deliciously pure water, which would obviously have been a focus for settlement for early colonists, seeking homes in the Long Forest which once covered a wide area from Hopedale to the Stiperstones. It also stands at the meeting-point of three ancient causeways: a prehistoric packhorse track, passing along a 'hollow-way' at places up to 40 feet

deep and leading to a packhorse bridge in the village at the bottom of the hill; a track leading to a remote shrunken village called Middlehope in Hopedale, which once boasted a Norman castle, and a Roman road, part of whose surface we uncovered. This seems to have been part of the line of advance of a Roman army based at a fort called Wall Town near Cleobury Mortimer, when attacking the forces of Caractacus, the British leader, whose headquarters were at the great hill-fort named after him, Caer Caradoc, whose top I can just glimpse above a line of hills to the west. 'My' Roman road, it seems, was later extended to join Watling Street, the road which runs from London to Viroconium, known as the 'Birmingham of Roman Britain', and then turns south-west to end at the Roman fort of Kenchester, near Hereford. In Corvedale, it seems 'my' road passed by a Roman quarry at Bouldon which once supplied green roofing tiles for Viroconium.

In a paddock above the cottage is a circular earthwork. Shortly after arrival, I invited a horticultural adviser from the Ministry of Agriculture to help me to lay out the farm which runs to just over 20 acres. Standing on the vantage-point of the earthwork, the adviser suddenly remarked, 'This area shows the outline of a motte-and-bailey.' This is a kind of fortification erected by the Normans of which many remains can be seen in this much-fought-over frontier land. The motte is a circular mound which was surmounted by a wooden keep and the bailey a rectangular enclosure, originally stockaded, adjacent to it. In the adviser's opinion, the circular enclosure would have contained the motte, while the bailey stretched from the cottage in the form of a long rectangular patch of about an acre, which had obviously been artificially raised. Later, however, a visiting archaeologist suggested that the circular mound had been the site of a Celtic monastery – a ring of log-huts with a a small chapel in the middle – while a depression to the south of the 'bailey' might have been a monastic fishpond, fed by two streams which now disappear into a sump.

While the 'bailey' was to become the main focus of my activities at Highwood Hill, for the early years I concentrated largely on livestock: poultry, goats, sheep and cattle, as well as nine hives of bees. My first cattle were a bunch of Ayrshire heifers, which I bought from Sam Mayall of Harmer Hill, North Shropshire, one of the leading organic farmers of the day. These I had artificially inseminated and sold after calving as dairy heifers at Shrewsbury Market. Later I switched to the Channel Island breeds. The Jersey makes the ideal house cow for the small farmer. Apart from giving the richest milk, she is small, neat, docile, intelligent and friendly and can be treated as a pet, though the Jersey bull can be bad-

tempered and unreliable. However, I found the rearing of dairy heifers both too emotionally exacting and too time-consuming, and as I wanted to devote more time to fruit and vegetable growing, my last cattle were a small herd of single-suckling Welsh Blacks – the hardy, shaggy, long-horned breed which the ancient Britons drove into the fastnesses of Wales when retreating before the advancing Romans. I became very fond of these primitive denizens of the British countryside, and gave them all Welsh names such as Myfanwy, Arianwen and Melangell, the latter named after the Celtic patron saint of wildlife. As a very sturdy calf recently weaned by her mother at the age of nine months, Melangell, when suddenly startled – possibly by a wandering hen – made a dramatic leap over a fence and a water-tank. I can still see the startling spectacle of the hairy black doodlebug flying through the air.

As in Somerset, so at Highwood Hill I have been fortunate in securing help, advice and instruction from old-fashioned countrymen with a wealth of practical experience. When I first took up livestock rearing I had the assistance of three brothers, Harry, Victor and Geoff Tipton, whose grandfather, a famous local character named 'Boney' Higgins, had occupied my cottage when he was first married, and lived to be almost a hundred in another cottage which he built himself at the edge of a wood just above. 'Boney' was a mighty wielder of the scythe and two-handled saw and also a mighty consumer of cider made by his nephew, who was an itinerant cider-maker like the hero of Hardy's novel *The Woodlanders*. He also helped to build the little railway which used to pass the bottom of my land and which his grandsons helped to demolish.

Geoff Tipton, who had started his farming career as a three-horse wagoner at the age of twelve, was once described as an 'animal magician' because of his seemingly miraculous powers of transforming undersized, sickly, unthrifty animals, whether calves, lambs or kittens, into beautiful beasts, with the gleam of life in their eyes and the gloss of health on their coats. I once bought six 'cade' (orphan) lambs from him which he had brought up on the bottle. They developed into enormous dignified ewes, which looked like grizzly bears when sitting on their backsides to be shorn, and which flatly refused to be 'worked' by my border collie, but stamped their feet at him.

I got great enjoyment from my animals. In general they seemed happy, contented and very healthy under my 100 per cent organic regime. Intimate, co-operative contact with another order of life, as in hand-milking or helping a calf into the world, is a profoundly satisfying and moving experience. This is attested by the beautiful milking-croons which Hebridean herd-girls used to sing to their 'kyne' to keep them still while

milking and to promote the flow of milk. My first initiation into an ecological experience was gained when riding in a London park, when I discovered the possibility of telepathic communication with my horse via its deeply expressive ears, which seemed like radio antennae capable of being attuned to one's unspoken thoughts. Such experiences immensely enrich one's life. The ultimate ideal, in a more truly ecological society, would be for human beings generally to develop intimate relationships with animals leading entirely free and natural lives in the wild, like those between Joy Adamson and the lioness Elsa and between Horace Dobbs and his dolphin friends.

The humanitarian and economic arguments against exploiting animals for food and other products became, for me, inescapable. This realisation began to dawn when rearing dairy heifers. The separation of the newborn calf from its mother, which is an essential factor in commercial milk production, became a more and more unbearably pathetic experience. That is one reason why, though a vegetarian, I switched to single-suckling, even though the end-product of single-suckling is beef. Eventually I disposed of all my livestock. For me it was the only way. Because I was so fond of all my animals, even the hens, the prospect of their eventual slaughter became more and more intolerable. Moreover, at this time of widespread hunger and starvation in the Third World, the rearing of big livestock such as cattle is an unforgiveably wasteful form of land-use. The growing of crops, above all tree-crops, is a vastly more productive way of using agricultural resources which, in many countries, are rapidly diminishing in relation to the growth of populations.

For me the idea of a system of land-use capable of supplying all basic human needs, consisting mainly of trees and other perennial plants with no livestock component, was a case of gradual evolution. While I was writing my first book, *The Inviolable Hills*, Eve Balfour, one of the pioneers of the organic movement and founder of the Soil Association, who wrote the preface, sent me an article which I found more exciting than any detective story. The author, James Sholto Douglas, described a new system of land use which he was operating in the Limpopo Valley of southern Africa, which I felt had worldwide implications. Called Three-Dimensional Forestry or Forest Farming, it was pioneered by a Japanese, Toyohiko Kagawa, who will surely come to be acknowledged as a universal genius on a par with Leonardo da Vinci. Christian evangelist, scientist, novelist, poet, linguist, political reformer, and one of the founders of the Japanese trade union movement, his concern with the total human condition was comparable with Gandhi's. In the 1930s the focus of his concern switched to the plight of Japan's mountain farmers, who were finding their livelihoods threatened

by soil erosion caused by deforestation – a problem that has since spread to many other parts of the world. While studying at Princeton, Kagawa had come across J Russell Smith's classic *Tree Crops – A Permanent Agriculture*, which emphasises the value of the tree as a multi-purpose organism, providing not only food and a host of other useful products, but also protection for soils and water supplies. Inspired by this book, Kagawa managed to persuade many of his country's upland farmers that the solution to their erosion problem lay in widespread tree-planting, and that they could gain a bonus from this if they planted fodder-bearing trees, such as quick-maturing walnuts, which they could feed to their pigs. Thus the three 'dimensions' of his '3-D' system were the trees as conservers of the soil and suppliers of food and the livestock which benefited from them.

Impressed by the vast potentialities of '3-D', Sholto Douglas, after meeting Kagawa in Tokyo, carried out a number of experiments in various parts of southern and central Africa, in conjunction with UNESCO, to test the applicability of the system to different soils and climatic conditions. Among trees which he found particularly useful were several leguminous bean-bearing trees, especially the carob and algaroba, which fertilise the soil for the benefit of grass and other plants by the injection of nitrogen, as well as providing food for people and animals.

While collaborating with Sholto Douglas in the preparation of the book *Forest Farming*, which has been widely read around the world, I gave much thought to the possibilities of extending the system to temperate countries such as Britain. Observing the habits of my own cattle, it occurred to me that the traditional multi-species English hedgerow, which I saw being browsed throughout the year, even in the depths of winter, fulfilled some of the functions of Kagawa's and Douglas's fodder-bearing trees. Moreover, after reading *Fertility Pastures* by Newman Turner and *Herbal Handbook for Farm and Stable* by Juliette de Bairacli-Levy, I realised the value of hedgerow and pasture herbs, not only as adding minerals and other nutrients to the animals' diet, but also as agents for the prevention and cure of disease. Some traditional English farmers believed, I am sure correctly, that if a cow felt she was sickening for some disease, she would seek out the requisite healing herb.

On the basis of these findings, I developed my own '3-D' system which I called 'OPS' - Organic Perennial Subsistence farming. That involved 'cultivating' my hedgerows by encouraging the growth of plants which contain substances particularly nourishing for cattle, such as the elder, wild rose and hazel, and sowing some of the many perennial pasture herbs recommended by Newman Turner, such as chicory, ribwort, yarrow and sheep's parsley.

But my primary aim was self-sufficiency, so I extended my system beyond livestock farming to include trees and other plants – mainly perennial – which would contribute to the health and welfare of human beings. In time, after I had adopted a vegan diet and for other personal reasons, the plant component completely replaced the animal one, and, after making a study of companion planting, I renamed my system 'Ecological Horticulture' or 'Ecocultivation'. I then discovered that other people were working on similar lines in other parts of the world and that the generally accepted generic term for all such systems was 'Agroforestry'. So I adopted that term for my own.

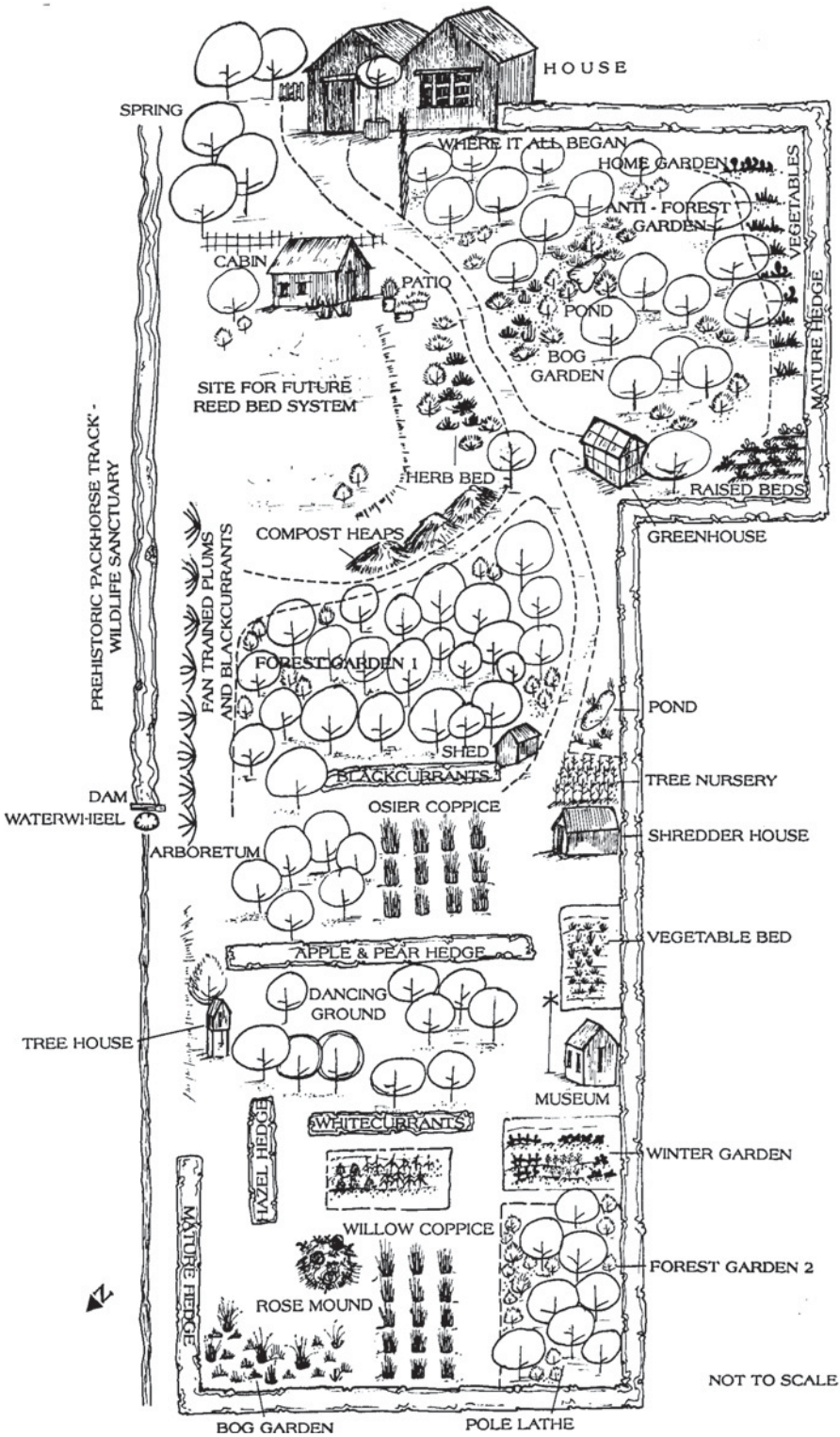


Fig. 4 Plan of the author's garden

Chapter Five

The Wenlock Edge Project

My small farm, which stretches up to the edge of the woods which clothe the top of Wenlock Edge, was originally carved out of the open fields of the mediaeval village community. A relic of the original enclosure was a long narrow paddock bordering a stream, which was called the 'The Slang', a name for one of the strips into which the open fields were divided. The communal lands were equitably laid out to enable each of the villagers to have his share of the different types of land which the parish comprised: cornfields, upland pastures and lowland meadows. In certain lights the strip-pattern can be clearly discerned on my largest field.

In laying out Highwood Hill, as I called the farm after one of the woods above it, I originally designated five small pasture fields and two orchards, in one of which I kept a flock of free-range hens, as the cash-component. These were eventually taken over by a community.

My self-sufficiency efforts were concentrated on the 'bailey', which is a tongue of land of about one acre, beside and behind the cottage, and the adjacent depression which the archaeologist surmised had been a monastic fish-pond. While this was mainly occupied by a plastic tunnel for winter vegetables, I divided the 'bailey' into a garden of herbs and perennial vegetables, which meant digging up the lawn; a blackcurrant plantation; a tiny orchard of apples, pears and damsons; and a large vegetable garden. The small orchard, about one-eighth of an acre, was to become my model forest garden.

The small garden of herbs and perennial vegetables lay literally outside the kitchen door, on the south-west side of the cottage – an ideal position. It was a suntrap, protected from north and east winds, and the person preparing a meal could nip out, just before serving it, to pick a handful of fragrant greenery, fresh from the soil, to add to salad, soup or stew. We found many uses for the plants that grew there. Lovage, that statuesque plant which can grow over eight feet tall, can be used as a piquant substitute for celery, to which it is related. Lemon-balm, eau-de-cologne mint and peppermint can give an original tang to fruit-salads. Sweet cicely can

reduce the tartness of stewed gooseberries or blackcurrant pie. Good King Henry, a wild form of spinach, also known as 'Lincolnshire asparagus', can be added to stews, as can the young leaves of dwarf comfrey – one of the few herbs that continue to put out leaves during the winter. The leaves of sorrel, with their mild lemon flavour, and wild garlic, with its not-so-mild reminder of its cultivated cousin, make an interesting substitute for lettuce in salads.

From the first, these exciting plants inspired experiment. I realised that perennial herbs, with their deep roots tapping the minerals in the subsoil, could make an invaluable contribution to nutrition over and above their curative and prophylactic powers. I tried passing them through the juice-extractor together with our home-grown apples, pears and blackcurrants, to produce delicious non-alcoholic 'liqueurs'. Peppermint, eau-de-cologne mint and other herbs, added to apples, plums, damsons and dried apricots – the whole pressed through a colander after stewing – produced uncommon jams, 'cheeses' and chutneys. Moreover, honey from our own hives, the inhabitants of which were particularly attracted to the blueish flowers of balm and comfrey, added yet another dimension of nourishment and flavour. A range of 'Herb and Honey Products', which I developed, included *Rejuce*, a herbal slimming drink, and attracted the attention of a director of a newly formed health-food manufacturing company, which I was invited to join. Unfortunately the time did not seem ripe for its activities and after a short period, it folded up.

But I continued to work – or rather not-work – our herb-garden. The plants, I found, could look after themselves very nicely, thank you. All they needed was a dressing of straw or compost in the winter, and every spring they faithfully re-appeared, sending out fresh shoots and leaves for months on end. Pests and diseases were conspicuous by their absence.

My creative faculties were also attracted to another traditional aspect of these fascinating plants: their reputed ability to extend their vigour, health, disease-resistance and pest-resistance to neighbouring plants. At the far end of the 'bailey' Harry and Victor Tipton laid out a large garden of conventional vegetables. Among these I planted rows of applemint, borage and other herbs – and the vegetables seemed to like them. They grew well, even though the herbs rapidly became rather too rampant. I saw cabbages struggling manfully through mini-jungles of borage. Borage, though an annual, is an avid self-seeder and, in its second year, the vegetable garden seemed to shimmer in the electric-blue haze of its ever-present flowers.

Another experiment I made in the vegetable garden was a system of 'organic irrigation'. I got a local engineer to make an adjustable valve that

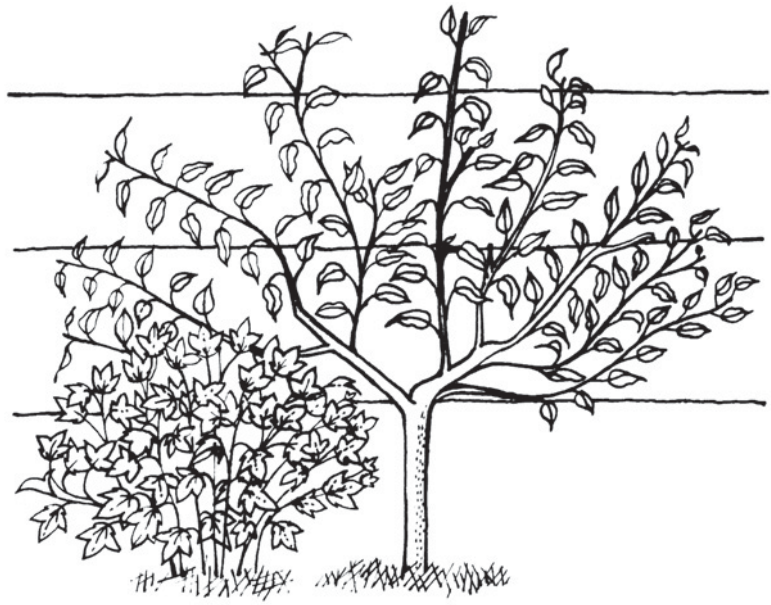


Fig. 5 Fan-trained plum tree with blackcurrant bush

could be fitted to the pipe from which the spring emerged beside the cottage. To this was attached a length of alkathene piping extending to the far end of the vegetable garden, which was on a gentle slope. Taps were fitted at intervals of about twenty yards. Channels were then dug by mattock from top to bottom of the vegetable garden, on both sides, and between the rows of vegetables. In order to water a double-row of vegetables, all that was necessary was to turn on the nearest tap and direct the water to the vegetables by mattock, smoothing and hardening the channel bottoms. Water was also switched from channel to channel by means of small dams of compost or manure. That was where the 'organic' element came in, as particles of compost or manure were washed down the channels, to which was added liquid seaweed. The whole area was thus, in time, thoroughly fertilised.

The task of clearing the channels of loose mud and mole-hills and constructing new channels was greatly facilitated by the force of water gushing from the taps. The mattock was used as a multi-purpose tool: while digging channels, one also hoed, weeded and earthed up the vegetables. The whole system was beautifully simple, easy and cheap.

However, in comparing the garden of conventional vegetables with the garden of herbs and perennial vegetables, it was obvious which demanded the least work. In growing annual plants one can't avoid the arduous and

fiddlesome chores of digging, raking, preparing seed-beds, sowing, transplanting, thinning out, hoeing, weeding, watering and fertilising. But the herbs and perennial vegetables, once established, needed little or no watering or fertilising, because their deep roots drew up water and minerals from the subsoil, for the benefit of themselves and each other, and they did not even need hoeing and weeding, as they quickly spread over the whole surface of the soil, suppressing all competitors, while their intricate tangle of roots maintained a porous soil-structure. All they did need was periodical thinning-out, to prevent them from encroaching on each other, but, as they constituted an important part of our daily diet, a fair proportion of the thinnings found its way into the kitchen.

Pondering on the contrast between the two gardens, it came to me that, if one could devise an integrated system of land-use consisting mainly of perennial plants – fruit and nut trees and bushes together with perennial vegetables and herbs – as well as a diet based on this mix, the task of achieving self-sufficiency would be vastly simplified. This is how I discovered agroforestry.

The decisive event which enabled me to work out a demonstration of how agroforestry could be applied in the conditions of western, largely urban, civilisation, where in general only small plots of land are available for self-sufficiency enthusiasts, was the advent of Garnet Jones. Living in the village at the bottom of the hill, he is a Celt of magnificent physique, who comes from an old yeoman family in the wilds of Mid-Wales. While his whole nature is steeped in traditional country lore and his roots are deep in the soil, he has an alert and lively mind, receptive to new ideas. A true yeoman, he can turn his hand to a wide variety of practical tasks, and, having also worked on the railway, he shows something akin to genius as an engineer. He is of the stuff of the countrymen, who, torn from the soil, pioneered the Industrial Revolution in the Ironbridge Gorge area of Shropshire and elsewhere in Britain. His enthusiastic participation in the Wenlock Edge Project has been intensely stimulating, while his muscle-power and brain-power have been invaluable. The creation of the project has been a partnership between us.

The project now comprises a number of sectors:

1. The main *Forest Garden*, literally the centrepiece.
2. The *Ante(i) Forest Garden* (AFG), so called because it comes before (ante) the main forest garden and contains plants requiring full sunlight and/or acid soil, which are therefore antagonistic (anti) to forest garden conditions.

3. The *Homegarden*, an area about twenty metres square immediately adjacent to the house, containing fruit, vegetables and herbs, which, for some mysterious reason, is exceptionally productive. So-called because 'homegarden' is the term by which most tropical forest gardens are known.
4. *Where It All Began*, a strip of economic plants surrounding an old Improved Fertility pear outside the back door – a tiny microcosm of the whole project.
5. *The Patio Garden*, a small assembly of plants in tubs, designed to demonstrate that even towndwellers with only small paved yards can enjoy some of the benefits of the Forest Garden.
6. The *Wild-life Sanctuary*, a prehistoric packhorse track, possibly a stone axe trading route, which constitutes a very deep cutting or 'hollow-way' along the garden's northern boundary. As it contains some magnificent old trees, it can be regarded as a strip of ancient, natural forest. It is left completely undisturbed and is scheduled as a Prime Site of Conservation Interest.
7. The *Osier Coppice*, cut once a year for basketry.
8. The *Arboretum*, containing specimen trees of special interest, including Shagbark Hicory (*Carya ovata*), which has been described as 'the most valuable nut-producing species in the USA'; Silver Maple (*Acer saccharinum*); Arolla Pine (*Pinus cembra*); Maidenhair Tree (*Ginkgo biloba*) and Dawn Redwood (*Metasequoia glyptostroboides*), two 'living fossils,' typical of the vegetation that created the coal measures 100 million years ago; Antarctic Beech (*Nothofagus antarctica*), probably the most southern tree in the world; Red-twigged Lime (*Tilia platyphylios rubra*); Red Oak (*Quercus rubra*), an American species noted for its brilliant autumn colouring; Service Tree (*Sorbus domestica*), which bears small edible fruit known as 'chequerberries', German Walnut (*Juglans regia*, var. Buccaneer), an early-fruiting variety, and White Mulberry (*Morus alba*), which produces both edible fruit and leaves which are used for feeding silkworms.
9. The *Circle-dancing Area*, a small open space surrounding the Massingham Oak, where dancing takes place during seasonal festivals. It is overlooked by the Tree House, built part-way up a living ash, which constitutes an irresistible attraction for children. Also nearby is the *Ecological House*, a small cabin built very expertly by Garnet

Fig. 6 Circle-dancing round the oak tree, with the Chinese goddess of mercy

(who also built the Tree House), which is lit by a wind-generator and contains a small collection of interesting examples of craft-work from several parts of the world.

10. The *Winter Garden*, a number of beds and a mound, mostly unshaded, designed for winter vegetables.
11. *Forest Garden No.2*, a small multi-storey plantation surrounding the Kagawa Plum.
12. The *Bog Garden*, a plantation of reeds and other plants requiring damp conditions, irrigated by Garnet's waterwheel in the Pack-horse Track.

The main Forest Garden has contained over 100 species and varieties of plant in its very limited area – about that of a large town garden – but

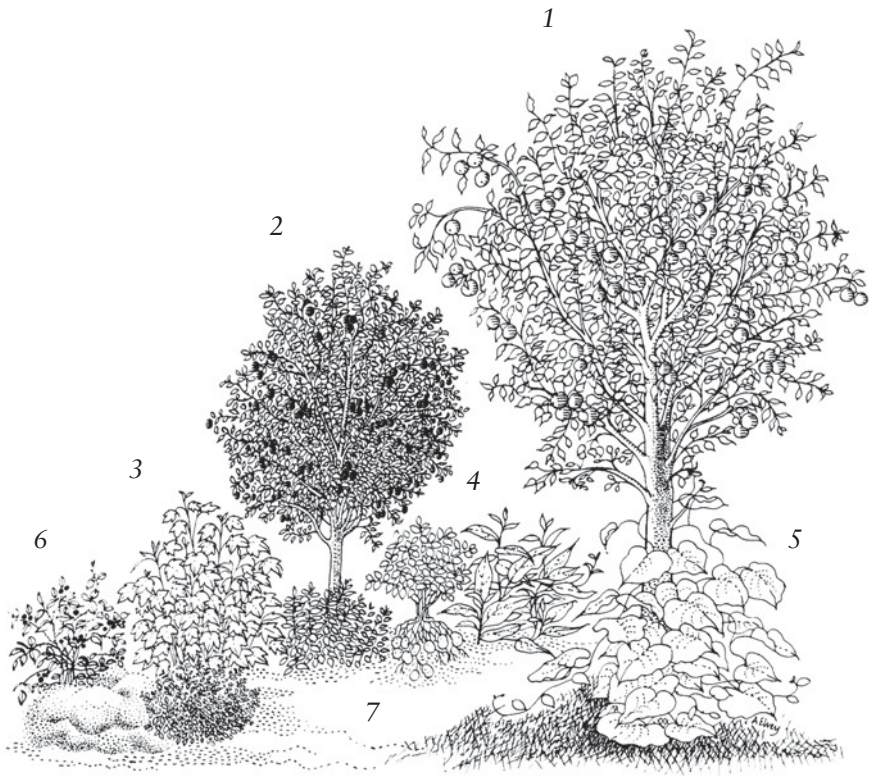


Fig. 7 Cross-section of temperate forest garden, showing seven 'storeys': 1. Canopy – largest fruit trees. 2. Lower fruit trees – dwarfing fruit trees. 3. Shrubs – currants and berries. 4. Herbaceacous – herbs such as comfrey. 5. Vertical-climbing berries and vines. 6. Soil surface – dewberries and creeping herbs. 7. Rhizosphere – vegetables and root layer.

some have not been fully adapted to the conditions and have died off. At present the number of species and varieties is at least seventy and others are being added every year. Like the natural forest, it is a largely self-regulating, developing ecosystem that requires minimal maintenance.

The 'storeys' comprise:

'Canopy': standard or half-standard fruit trees;
'Low-tree layer': fruit and nut trees on dwarfing rootstocks and bamboo;
'Shrub layer': currant and gooseberry bushes and Rosa rugosa;
'Herbaceous layer': herbs and perennial vegetables;
'Ground-cover layer': creeping plants such as rubus species;

Fig. 8 An artist's impression of the forest garden

'Rhizosphere': shade-tolerant and winter root-plants;
'Vertical layer': climbing berries, nasturtiums, runner beans and vines, trained up trees, over fences and over a shed.

The system is self-perpetuating, because almost all the plants are perennial or active self-seeders, such as borage and cress; self-fertilising, because deep-rooting trees, bushes and herbs draw upon minerals in the subsoil and make them available to their neighbours, and because the system includes edible legumes which inject nitrogen into the soil and mineral-rich plants such as buckwheat, which inject calcium; self-watering, because deep-rooting plants tap the spring-veins in the subsoil, even at times of drought, and pump up water for the benefit of the whole system; self-mulching and self-weed-suppressing, because rapidly spreading herbs, such as mints and balm, soon cover all the ground between the trees and bushes and thus create a permanent 'living mulch'; self-pollinating because the trees are carefully selected to be mutually compatible or self-fertile, and because the flowering herbs attract pollinating insects; self-healing, because the scheme includes a number of aromatic herbs, which undoubtedly deter pests and disease-germs and exhale healing radiations; resistant to pests and disease, because of the aromatic plants, and because any complex comprising a wide spectrum of different plants does not allow the build-up of epidemics such as affects monocultures.

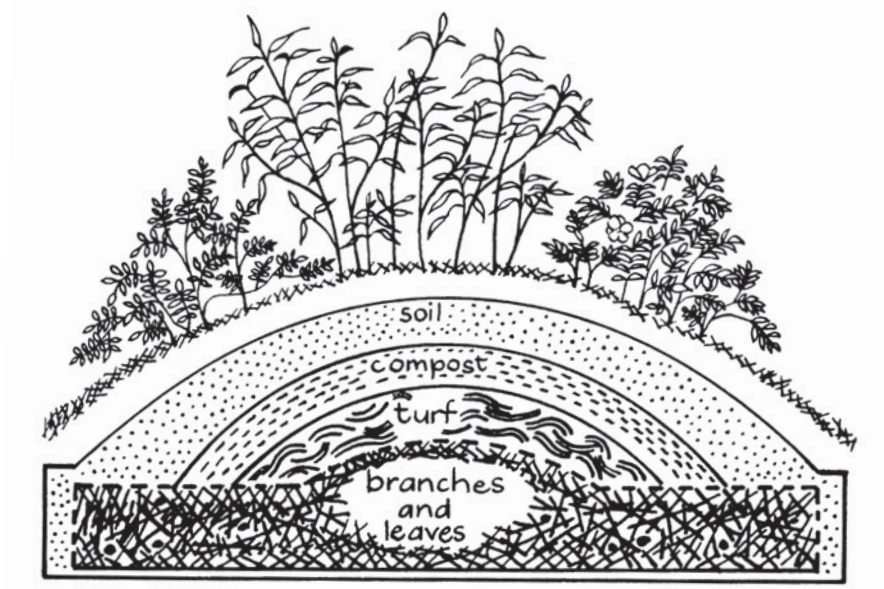


Fig. 9 Rose-mound showing construction layers

This forest garden model, which could be reproduced even in smaller areas, and in town gardens and wastelands, could, when well established, enable a family to enjoy a considerable degree of self-sufficiency for some seven months in the year, in the very best foods for building up positive health.

The Ante(i) Forest Garden, with its annual vegetables, sun-loving herbs and strawberries, as well as some fruit trees and bushes, is conveniently situated immediately outside the back door – one minute's walk from the kitchen. And, in approaching it, the first sight that meets one's eyes is Where it All Began: my first experiment in companion planting or plant symbiosis. It consists of a small Improved Fertility pear closely surrounded by black, white and red currants and herbs. I can never remember the little pear-tree or the currants failing to give bumper crops, a sign that they seem to enjoy each others' company as well as that of the herbs. A tiny area, yet intensely productive, year after year.

Just inside the gate is another mini-plantation: the Patio Garden, designed to demonstrate to the town dweller that it is possible to have a forest garden even if one has no garden at all, but only a paved yard. It comprises plants in tubs and trained up a trellis. Most of the plants are lime-haters, so they wouldn't thrive in ordinary soil anyhow. Growing in ericacious (or 'heath-soil') compost and peat, they include four blueber-

Fig. 10 Bouché-Thomas hedge

ries and a witch-hazel. There is also a dwarf 'Lilliput' apple and an ornamental gooseberry as well as the – to me – inevitable herbs. Two dwarf roses enhance the gaiety of the scene.

Nearby are two further 'anti' beds, containing plants that would not enjoy forest garden conditions, because, in their native state, they grow in treeless bogs, heaths and grassland. The bog-garden comprises peat spread over a plastic sheet to restrict drainage; it contains cranberries and other *vaccinium* species as well as a flowering rush and Siberian iris. The sun-loving herb garden comprises typical downland plants, such as thyme, marjoram, yarrow and rue, growing in a light soil, also mixed with peat.

Another device of interest to the town dweller with very restricted space is the mound-garden. Originating in China, like so many other down-to-earth practical ideas, mound planting has been taken up with enthusiasm in Germany, where it is called '*Hugelkultur*'. Unlike the raised bed system, which involves double-digging, you start the mound by making a trench about one-foot deep. This is piled up with woody material, such as small branches, hedge cuttings and prunings, to make a firm but highly porous core, enabling air, water and sunshine to circulate freely. This framework is then covered with sods, placed grass-side downwards,

Fig. 11 The Packhorse Trail

followed by a layer of compost, the whole being topped with soil. Plants are grown both on the top and sides of the mound, so that the space-saving advantages are obvious. It should be said, however, that the mounds gradually sink, so that they have to be periodically renewed. The AFG contains three such mounds.

Fig. 12 Arch of Gaia

Along the north boundary of the AFG is a 'Bouché-Thomas' hedge, consisting of apple trees planted diagonally so that they grow into each other and so create a rigid fence. I first learned about this system in an article by the gardener of Caldey Island monastery, off South Wales, where the system was formerly used to provide windbreaks for asparagus.

Approached through the wrought-iron 'Arch of Gaia', created by my next-door neighbour in the valley, who lived with his wife and a multitude of dogs and cats by the packhorse bridge, the arboretum contains a wide variety of trees, as well as the ecological house 'Cookery Nook' with its wind-generator and a waterwheel, which will be described in more detail in later chapters.

As with my animals, so I have developed warm personal relationships with many of my trees. Until I came into intimate daily contact with a large concourse of young trees, with a wide diversity of shapes, colours, sizes, habits and uses, I never realised how fascinatingly individual trees can be. In early spring it is a daily thrill to watch the ways in which different trees spring into new life. Some of my most valued trees – which are not necessarily the most valuable – have been named after people to whom they have been dedicated; people, some famous, some obscure, who have influenced my life and thought.

The practice of tree dedication began when a couple, David and Stella

Griffiths of Middlesbrough, who showed an interest in my agroforestry experiments, expressed a wish to plant four trees in memory of their parents. They asked me to choose the trees which I considered most suitable, and I bought from a local nursery four wild cherries – a species that will for ever be associated with Shropshire through A E Housman's lines:

> Loveliest of trees, the cherry now
> Is hung with bloom along the bough,
> And stands about the woodland ride
> Wearing white for Eastertide.

The cherries were planted in the AFG as the arboretum had not them been started.

Pride of place in the arboretum must go to the English oak commemorating H.J. Massingham, that eloquent defender of the English rural tradition to whom I owe so much.

Other trees and their dedicatees include:

Atlas Cedar: Richard St. Barbe Baker and his great scheme for Sahara reclamation;

Southern Beech (*Nothofagus antartica*): Edward Adrian Wilson, naturalist, doctor and antarctic explorer, who died with Scott;

Western Red Cedar (the totem pole tree): Chief Seathl, whose ecological-ethical philosophy is relevant to some of the profoundest problems of today;

Shagbark Hickory: Tsikatsitsiakwa (known as 'Katsi'), a Mohawk maiden who established a Permaculture group in New York State;

Shropshire Damson: Mary Webb, the novelist, a Shropshire damsel;

Sugar Maple: Helen Nearing, whose classic on self-sufficiency *Living the Good Life* was written in collaboration with her husband Scott;

Red Lime: Blanche Cazalis, a charming Parisian artist who introduced me to *Tisane de Tilleul*, lime-flower tea;

Chestnut Marron de Lyon: Claude Monet, my most beloved of landscape painters;

Scots Pine: Marjory Kennedy-Fraser, collector and arranger of Hebridean folk-songs;

Fir (*Abies grandis*): Leos Janacek, the composer who put his beloved Moravian forests into his opera *The Cunning Little Vixen*;

Arolla Pine: Rainer Maria Rilke, the German-Czech poet to whose tower-retreat in Switzerland I made a pilgrimage during my last holiday abroad;

Walnut 'Buccaneer' (a German hybrid): Johann Wolfgang Goethe, uni-

versal genius, whose pioneer botanical work revealed the *Urpflanze*, the primal plant;

Japanese Red Cedar: Toyohiko Kagawa, another universal genius who originated Forest Farming;

Apple *Court Pendu Plat* (said to go back to Roman times): Virgil, epic poet who also created an agricultural masterpiece, the *Georgics*;

Apple 'Flower of Kent': said to be the tree that inspired Isaac Newton's Theory of Gravity;

Monkey Puzzle (*Araucaria araucana* – from Chile): Victor Jara, the Chilean folk-singer martyred in 1973;

Himalayan Whitebeam: Murlidhar Devidas Amte, whose heroic struggles on behalf of leprosy sufferers, of Indian aborigines and their rainforest home have been of truly Himalayan proportions.

Chapter Six

Plant-life: Its Infinite Potentialities

'There is incredible generosity in the potentialities of Nature. We only have to discover and utilise them.' So wrote Schumacher in his foreword to *Forest Farming*.

Of some 300,000 known species of plant, only some 150 are grown regularly and to any considerable extent to meet human needs. Largely for commercial reasons, the plant production in western or westernised countries has been mainly reduced to a small number of standardised staples, grown under monocultural conditions and subjected to a wide range of chemical treatments. Today we rely on a mere twenty species to provide ninety per cent of the world's food needs and over half humankind's calorific intake is supplied by just three grasses: wheat, rice and maize. For this highly restrictive form of food production only eight per cent of the world's soils are considered suitable.

Thus there is a staggering neglect, not only of useful plants but of areas where useful plants can be grown, as indigenous peoples know. Areas such as the rainforests, with their vast diversity of plants whose uses are known or remain to be explored, are ruthlessly destroyed, to be replaced by pastures designed to provide a single food-product – beef – in infinitesimal quantities compared to the productivity of the natural forest. The wastefulness of 'orthodox' agriculture and horticulture is unspeakable. Because it 'pays' best to specialise in only one product at a time, all other plants are neglected or destroyed. In exploiting a tropical forest for the sake of a single timber, such as mahogany or teak, all other plants, and even up to eighty per cent of the timber trees themselves, are abandoned. Modern plant breeding techniques have evolved the possibility of still further increasing the range of useful plants available, but many 'improved' hybrids can only flourish if heavily dosed with chemical fertilisers and sprays and copious irrigation, which puts them beyond the reach of all but the richest farmers and landowners. Hence the failure of the much-heralded 'Green Revolution' to solve the heart-breaking problems of food

shortages in the Third World.

Over the years, on this small sector of a chilly Welsh Border hillside, we have successfully grown 200-300 species and varieties of useful plants, from exotic vegetables in the AFG to unusual trees in the arboretum, with a solid core of Old Reliables, mainly concentrated in the forest garden, to ensure a degree of self-sufficiency throughout the year. I have even experimented with two 'miracle plants' that could play key roles in feeding the Third World. These are amaranth, a vegetable-cereal much prized by the civilisations of the Incas and Aztecs, and the winged bean, which originated in Papua New Guinea. Amaranth belongs to a small and highly select 'club' of plants, whose powers of photosynthesis are more efficient and potent than those of the majority. Photosynthesisis, the process by which chlorophyll, the green pigment in plants, combines carbon dioxide from the atmosphere with hydrogen from water to create carbohydrates, is the basic process on which all physical life depends. The carbohydrate content of amaranth seeds is comparable to that of conventional cereals but the protein and fat content are higher. Moreover amaranth also has leaves comparable in nutritional value to those of spinach. The winged bean, a leguminous plant with the nitrogen-fixing, soil-improving qualities of most members of its tribe, is edible in its every part: seeds, pods, flowers, leaves and stems; it even has tubers, with four times the protein content of potatoes.

A common quality of both amaranth and winged bean is their ability to thrive in both tropical and temperate climates, though the winged bean grows much larger in the tropics, where it can become a vegetable colossus with tendrils thirty feet long. Both plants are specially suitable for mixed cropping procedures, such as agroforestry, so they can become constituents of land-use systems vastly more productive than monocultures.

I myself have grown amaranth and winged beans in conjunction with some of the many fascinating salad vegetables introduced by Joy Larkcom and others from the continent of Europe and the Far East. The vegetable garden, I believe, should be as decorative as the flower garden; in fact a number of flowering herbs make 'good companions' for vegetables, and should be interspersed among them. In some cases the flowers themselves, including those of pot marigold, bergamot, nasturtium and borage, are edible and greatly add to the appetising appearance of salads. Some of the many chicories now available are attractive both for their sky-blue flowers and for their leaves. The Italian 'Treviso' chicory, for example, starts green but transforms itself in the autumn into a pyramid of crimson, sharply pointed leaves. 'Grumolo', a very hardy chicory from the moun-

tains of Piedmont, hugs the ground as a tight rosette during the winter but in spring forms a tall, narrow pagoda.

To economize time, labour and money, I favour vegetables that are perennial, such as sorrel, Good King Henry, tree onions, wild garlic, seakale and cardoon; that readily self-seed, such as land cress, spinach and Japanese edible chrysanthemums (*shungiku*); or that re-sprout after cutting, such as some lettuces, some brassicas, 'Sugarloaf' chicory and Chinese cabbage. My favourite super-hardy winter vegetable is 'Pentland Brig' kale, or borecole, which used to be known in its native north-east of Scotland as the 'green doctor', because people believed that those who regularly consumed it never needed medical attention.

Perennial vegetables, together with edible and medicinal herbs, constitute the 'herbaceous storey' of the forest garden, while root vegetables occupy the rhizosphere. The root mound is host to a number of vegetables suitable for forest conditions, including Hamburg parsley, which tolerates shade, and winter radishes, which come into their own when perennial plants die down.

The remaining 'storeys' of the forest garden mainly comprise fruit and nut trees and bushes, together with wild strawberries and *rubus* species, such as the strawberry-raspberry and dewberry, which hug the ground.

No epicure dish served at the most exclusive restaurant can compare with fresh fruit, organically grown without chemicals, picked from one's own garden.

Perhaps the most delicious of all eatables is the true greengage, which is said to have been introduced into Britain from the mountains of Central Asia in ancient times, probably by mediaeval monks. Though a vigorous tree, it seldom crops well, but there are other gages which, while perhaps lacking the 'Oriental' scented flavour of the original wild species, taste almost as good. One of these is the Early Transparent Gage, described as 'a connoisseur's fruit of the highest quality'. Another is Denniston's Superb, of which I planted several specimens in my main orchard. These have grown into large, hardy, trouble-free trees which seldom fail to give an abundant crop of honey-sweet fruit.

In many parts of Britain it should be possible, if one has a reasonably large garden, to enjoy one's own outdoor fruit every month of the year, from the first gooseberries, which ripen at the end of May, to the latest apples, which ripen in February and can be stored till June.

To extend the picking season as long as possible, one should try to buy at least three varieties – early, mid-season and late – of the fruits of one's choice. This is also desirable in the case of most trees, for the sake of cross-pollination. Almost every fruit tree needs another of a different vari-

ety – sometimes two others – for pollination; even those trees that are self-fertile tend to crop better if there are other trees of different varieties in the neighbourhood. Moreover, the complementary trees must blossom at approximately the same time.

Like other fruit, plums are divided into categories according to their times of ripening, from July to October. The best flavoured of the earlies is claimed to be a recently introduced variety called Opal, which regularly produces large crops of juicy red-purple fruit. A reliable old variety that is prolific, hardy and has good resistance to frost is Czar, whose black-purple fruit, however, is only considered suitable for cooking. Though I love to experiment with rare and choice fruit, it is good to have a solid nucleus of hardy standbys that won't let you down. Another example of these comes in the next time-category, mid-to late August; it is Purple Pershore. The best known of all British plums, Victoria, comes into the same categories of time and reliability, though it is susceptible to silver-leaf disease. The September plums include an epicure variety, Kirke's Blue, which is, however, a light cropper. The latest of all plums is another of my solid standbys, Marjorie's Seedling, which can be picked as late as December, provided there are no sharp November frosts. The damsons are also late-ripening and very hardy; when fully ripe, they are surprisingly sweet and can be eaten raw. The two best, which can be grown as hedges, are Farleigh and Shropshire Prune. All plums and damsons, including the 'cookers', are delicious eaten raw if left to stand for an hour or two with a covering of honey.

Apples are divided into six categories according to time of ripening. An apple is ready to pick when the stem swells and the fruit comes away after a slight twist. One of the best of the earlies is George Cave, a small crisp apple that crops well and is sometimes ready before the end of July. Moving on to early October, I find my Spartans have a wine-rich flavour that matches their purple hue – far superior to shop Spartans. Slightly later is my favourite apple, Sunset, a small crisp apple from the Cox stable, hardier and, to my mind, even more fragrant than its more famous relative. Later still are two recent introductions from East Malling, the finest fruit-breeding station in the world. They are Jupiter and Suntan, a cross between Cox and Court Pendu Plat. An old apple, dating back at least to 1720, is Ashmead's Kernel, a russet type that was once voted the best of all apples for flavour. Possibly the best keeper of all is a cooking variety Annie Elizabeth, which can be stored till June.

Pears can be divided into two categories: the richly scented, juicy but rather delicate French epicure varieties, such as Jargonelle and Doyenne du Comice, and the more down-to-earth English varieties such as

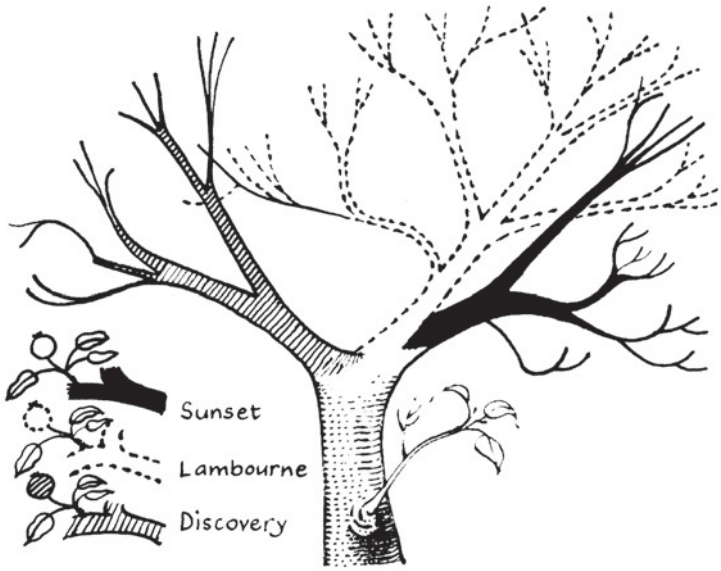


Fig. 13 'Family' apple tree

Improved Fertility, Hessle and Conference.

All bush and cane fruits, except blueberries, are suitable for the forest garden, because all will tolerate some shade. Along the fence above the Packhorse Track are fan-trained plums interplanted with blackcurrants. Along a short mound is a hedge of Ben Sarek blackcurrants, a recent introduction by the Scottish Crop Research Institute. They produce fruit as large and sweet as grapes. From the same Institute comes a mid-season raspberry, Glen Cova. Next to it is the very latest in autumn-fruiting raspberries, which form compact bushes which don't need staking. It is Autumn Bliss, a hybrid produced by East Malling – after years of endless patience – combining an Arctic raspberry, the American wild raspberry and no fewer than six old British varieties.

Raspberries are among the constituents of the forest garden's 'vertical' storey. They are trained along the fence above the 'monastic fishpond', together with cultivated blackberries and hybrid raspberry-blackberry crosses: Tayberry, Boysenberry and loganberry. Over two sheds are trained a Japanese wineberry and a hardy Brant vine, while another Brant vine is trained up an old damson tree. In the summer other trees are also entwined with nasturtiums and runner beans, whose flowers add gaiety to the greenery. A small greenhouse contains a strawberry vine.

I have also experimented with a number of fruit trees and bushes –

some rare, some common, all fascinating – whose nutritious products will never find their way into the shops. For me the most beautiful of all small trees are the ornamental crabs, some of which have bright red leaves. All have edible fruit, the best flavoured and largest of which are those of 'John Downie'. Crabapples are of special value in a forest garden setting, as they are good pollinators of ordinary apples. A genus of small trees which also has great potentialities for forest gardens is *sorbus*, the best known species of which is the rowan, of which I have an 'edible' variety. I write 'edible' with inverted commas, because the fruit are little less tart than those of the ordinary wild rowan, but they add an intriguing flavour to sweet fruit salads. 'Intriguing' is also the word for the flavour of the berries of another sorbus species, the whitebeam, while the berries of a rare English native, the wild service tree, have been described by Richard Mabey as having a unique taste with 'hints of tamarind, sultana, apricot and damson.'

Among berries of North American origin, those most valued by the Indians of British Columbia belong to a small tree or bush, variously called service berry, Juneberry, shadbush or Saskatoon berry, of which I have two specimens. When ripe, the berries are reddish purple to dark blue and vary considerably in size, texture and taste. There is wide scope for breeding improved varieties, as has been done with blueberries and cranberries. A large bush, called in Britain 'Worcesterberry', was once thought to be a blackcurrant-gooseberry cross, but it is now known to be a wild American gooseberry. Its small berries – deepest purple, almost black – are deliciously sweet. From the Far North of Canada as well as Scandinavia comes another much valued fruit, the cloudberry, which puts forth exquisite magenta blossoms as early as February, to be followed by berries like large orange raspberries. Also from the Far North comes the Siberian gooseberry, an *actinidia* species related to the kiwi fruit, two specimens of which, a male and female (essential for fruit production), have been trained over the trellis surrounding the Sanctuary. In China, the native *actinidia* is greatly valued as a multi-purpose plant. Its fruit are especially rich in Vitamin C; its seeds yield an oil which can be used as a substitute for sesame oil; its flowers yield scent; its leaves, rich in starch, protein and Vitamin C, are used for fodder; its roots have medicinal virtues; its fibres can be used for fine papermaking, and its abundant resin can be used in the manufacture of paper, dyes and plastics.

Just as George Washington Carver, the largely self-educated son of slave parents, showed extraordinary ingenuity in tapping the potentialities of the peanut, for which he found over 300 uses, as well as the soya bean – and thus introduced both products into world commerce – so the

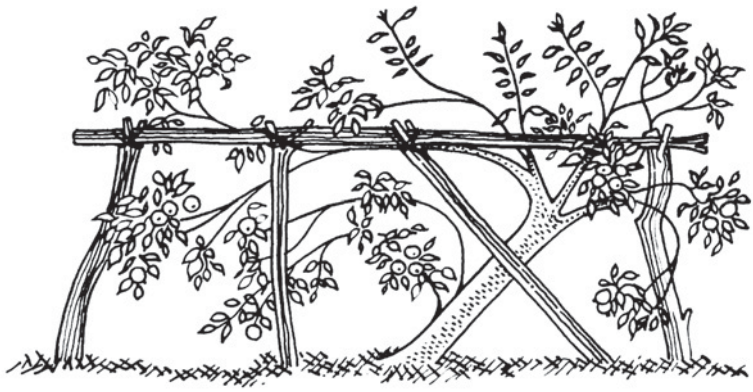


Fig. 14 George Cave apple tree with scaffolding to support branches borne down by abundant crop

Chinese have skilfully uncovered many uses for their own plants. I have two bamboos which I hope will some day send out edible shoots.

On one of the mounds is a Japanese *Rosa rugosa*, with large meaty hips the size and shape of small tomatoes. Rose-hips are said to be the richest of all sources of Vitamin C. The *Rosaceae* are a large and tremendously productive family of plants which includes most of our wild and cultivated temperate fruits. One member of the family which originated in North Africa, and of which a specimen grows in AFG, is the azerole, a hawthorn with quite palatable fruit shaped exactly like miniature apples. Nearby is a 'family' apple-tree: three compatible varieties of apple growing on a single rootstock. This is a very convenient method of introducing diversity into a small garden. I also have a 'family' pear and a 'family' plum. A fruit-tree which does not belong to the *Rosaceae* is the mulberry, of which I have two specimens, one black and the other white, the tree used for breeding silkworms.

Hazelnuts, the only nut-trees grown commercially in Britain for their fruits, constitute part of the 'low tree storey' in the forest garden, while there is a short hedge of mixed varieties, including 'Harry Lauder's Walking Stick', near the end of the arboretum. I am also experimenting with other species of nut-tree suitable for the British climate. These include the butternut and shagbark hickory from North America, a German hybrid walnut which fruits sooner than the English walnut and a French chestnut, '*Marron de Lyon*', which produces nuts larger than the sweet chestnut commonly grown in England. The arboretum also possesses a Swiss Arolla pine which can produce edible kernels. Other nut-pines capable of being grown in Britain include the Italian Stone pine, source of the pine-

Fig. 15 Oyster mushroom on logs

kernels sold in health food stores, which was first introduced into Britain by the Romans to supplement army rations.

Sweet chestnuts are sometimes known as a 'tree cereal', because in the south of France they are occasionally ground into flour to make bread and cakes. A small specimen of another 'tree cereal' grows in the forest garden. It is a honey locust, one of a number of bean-bearing leguminous trees, which include also the carob and algaroba, grown in Mediterranean climates. The honey locust is a poor and irregular bearer in the British climate, but there is little doubt that more productive varieties could be bred. In the tropics other 'tree cereals' include sago palms, bananas, bread-fruit trees and jackfruit trees. The worldwide reliance on a few staple cereals as basic factors in human diet, with all the uncertainties and expense involved, could be reduced if more use were made of cereal-equivalents grown on trees.

Protein deficiencies – a very serious problem in many parts of the Third World – could be remedied by far more widespread growing of mushrooms and other edible fungi. I have grown mushrooms in a small hut in the arboretum and in containers in the house, as well as oyster mushroom and brown-capped mushrooms in the greenhouse. The *shiitake*, an epicure fungus which grows on dead trees, has for centuries been cultivated in the Far East. The cultivation of edible fungi is very popular in Germany, where experience indicates that it would be a very suitable constituent of agroforestry systems. Many Germans grow fungi on logs in orchards, taking advantage of the shade provided by the trees. Blackberries are also said to be a suitable 'nurse crop' for many types of fungus.

The possibilities are infinite. A vast abundance of plant foods and cultivating techniques awaits thoroughgoing research and application. Moreover the know-how exists to make up for the deficiencies of nature by modern breeding techniques, such as genetic manipulation and tissue culture. Improved varieties can be produced with qualities such as better disease-resistance and cold-resistance. A search is continually in progress to re-discover the wild ancestors of cultivated crops, so that their genes can be utilised to re-invigorate their descendants.

If only the know-how could be equalled by the will-to-serve, by compassion for human suffering caused by hunger and deficiency diseases, there is no reason why fully balanced diets consisting largely of plant-foods should not be made available for hundreds of millions of undernourished people in the West as well as in the Third World.

Chapter Seven

Design and Maintenance

The Wenlock Edge Project is a minimal maintenance system. Garnet and I are very busy men who have no time for the High Art of Horticulture. For those who choose to practice that art numerous textbooks and manuals are available. Those who can't bear the sight of a weed or a gate tied up with string would do well to steer clear of Highwood Hill.

The First Principle governing all our decisions and activities has been Down-to-Earth Utility. And yet, strangely enough, that principle is not incompatible with beauty and delight.

The design and laying out of the project have been inspirational and pragmatic, a step-by-step process of development rather than working from a mathematically detailed blueprint. I would compare the result to a landscape sketch by Constable as opposed to one of his finished academic masterpieces. And, for that very reason, the whole set-up has, I believe, a more 'natural' appearance than the formal garden; it blends better with its environment.

D.H. Lawrence, writing of the 'sculptured hills and softly, sensitively terraced slopes' of Tuscany, stressed the naturalness of their beauty, 'because man, feeling his way sensitively to the fruitfulness of the earth, has moulded the earth to his necessity without violating it.' This has been my aim.

Largeish trees and other conspicuous objects constitute focal points in the design. At the junction between the forest garden and the AFG stands an ancient twisted damson with triple trunk, up which I have trained a Brant vine. Between the cottage and six rows of raspberries rises the stately form of an edible rowan, resplendent with orange-red berries in the autumn. Beneath its shade is a small pond and bog-garden. Along the north-eastern boundary of the AFG runs the Bouché-Thomas apple hedge. Close to the south-eastern boundary is a row of small but interesting trees or large bushes: a juneberry and an azerole, an edible hawthorn of Mediterranean origin. Between the forest garden and the arboretum stands the Arch of Gaia, festooned with roses, beside a blackcurrant hedge. At the other side is the Sanctuary, a small enclosure con-

Fig. 16 Hedgehog as seen in sanctuary

taining a frog-pond and a *Sorbus* Joseph Rock, which produces whitish berries. The north-eastern boundary of the forest garden, above the pack-horse track at its deepest point, comprises a trellised fence, with fan-trained plums interplanted with blackcurrants and with gooseberries in front. The south-western boundary, also a trellised fence above the 'monastic fishpond', has raspberries, blackberries and hybrid berries, such as loganberries. In the arboretum, between the osier coppice and an apple-and-pear hedge, the main focal point is provided by the striking reddish form of the dawn redwood, *Metasequoia glyptostroboides*, a 'living fossil', typical of the vegetation that flourished 200 million years ago and created the coal measures. Incredibly, and like its nearby cousin, the maidenhair tree or ginkgo, its ancestors had managed to survive in China alone, where it was discovered in a remote forest in 1941.

Liquid seaweed is the only spray ever used in the project. Its effect is not to kill pests or disease germs but to build up the plants' powers of resistance. At the same time, seaweed, whether in liquid or granular form, is a first-class soil conditioner. Extremely rich in minerals and trace-elements, originally washed into the sea from the land via rivers and streams, seaweed also has the ability to release minerals 'locked up' in the soil through compaction. We spray once or twice a year on a dull but rainless day – spraying in full sunlight has the effect of 'scorching' leaves.

While establishment of the project has involved a lot of digging and other hard labour, maintenance, as I have said, has been minimal. In fact

it grows less from year to year, as the trees and other perennial plants which have decided to stay, grow stronger, more deeply rooted, more stable and secure, and thus better able to withstand the onslaughts of pests, disease germs and weeds. The entire ground surface of the forest garden, except the part set aside for root vegetables, becomes more and more densely covered with a 'living mulch' of herbs, perennial vegetables and *rubus* plants.

Within this mulch certain weeds are tolerated. I agree with F.C. King, the humble gardener of genius who lived and worked in Wordsworth's county of Westmoreland, where he originated the No-digging system, that weeds can have an important controlled role to play in productive horticulture. With their deep roots drawing up minerals and water from the subsoil and their amazing adaptations for survival under adverse conditions, there is evidence that some weeds have beneficial, symbiotic effects on neighbouring plants, to which they impart something of their health, strength and vigour, but of course they must be kept in check. Some weeds are also of direct benefit to human beings, as sources of food, medicines and other useful products, such as dyes. I try to gain an intimate knowledge of the properties of of every plant in the complex, tame and wild, consulting Richard Mabey's *Food for Free* and *Plants with a Purpose* as well as several herbals. Among weeds which we eat are dandelions and nettles (warmed just sufficiently to remove the sting). Both are recognized to have outstanding nutritional qualities. For optimum health it is desirable to make one's diet as varied as possible, as every food has its own individual mix of vitamins, enzymes, proteins and other nutrients. Some weeds are a valuable source of minerals and trace-elements.

To suppress unwanted weeds, I spread straw thickly between the plants. In the forest garden this has to be done as soon as possible after the perennial herbs reappear in the spring. It is important to pack the straw tightly under fruit bushes and other large plants, to prevent weeds such as couch-grass, buttercups and bindweed – and, I must confess, mints – from growing up inside the plants. After adequate mulching, plants tend to grow freely and suppress competitors themselves. However, I periodically find it necessary, especially after rain when weeds can readily be pulled up by the roots, to embark on a 'crawl-and-claw' expedition through the undergrowth. Armed with a stout pair of gardening gloves, the most tenacious weeds can be clawed out from the interstices of valued plants. The fragrance of the ever-present herbs makes this an enjoyable and satisfying task.

To deal with weeds in the vegetable beds I find a mattock is the most effective tool.

The trees in the arboretum are planted in old pasture. To deal with weeds here I find constant cutting is reasonably effective. Even the most stubborn weeds such as docks and hogweeds tend to give up the struggle after a time, especially if cut in June and July when most of the vitality is in the tops, and when the roots tend to wither.

Weeding loses most of its daunting prospect as a back-breaking chore if carried out as a regular routine in connection with other work. During twice-daily picking sessions, when fruit, vegetables and herbs are gathered fresh for meals, I pull up most of the more obtrusive weeds in my path, adding them to the mulch. Picking in the forest garden is part of the process of pruning surplus growth and cutting back plants that encroach on their neighbours.

One way in which weeds can make themselves most useful is as a protective screen against birds during the fruit-ripening season. When gooseberries and currants start changing colour I refrain from pulling up bindweed and goosegrass in order to conceal the fruit from my feathered friends, who carefully time their nesting so that there is an abundance of juicy morsels with which to feed their fledglings. Apart from the weeds, anyhow, in the dense foliage of the forest garden, most fruits are far less conspicuous to the eyes of marauders than in the open conditions of conventional monocultures.

One year in the AFG I also made protective screens to protect vegetable seedlings not only from birds but also from slugs. It was after an entire generation of seedlings in the arboretum had been wiped out that I decided to make a comprehensive study of the likes, dislikes and habits of my slimy friends. I was determined to get even with them at all costs – except by the use of poisons. In this conservation project, poisons of any kind are taboo, even poisonous plants. Poisoned slugs can lead to poisoned birds, moles and hedgehogs.

Sir Albert Howard, one of the pioneers of the organic movement, regarded pests and disease germs as 'censors' of less-than-perfect health in plants, animals and soils. Any organism in a state of positive health has the ability to resist pests and diseases. At Howard's Indian agricultural research station, his cattle rubbed noses over the fence with cattle suffering from foot-and-mouth disease, and remained unharmed. It is said that a positively healthy plum-tree can even resist bullfinches. The reason for this is in the immune system, which nature provides for all organisms, including humankind. Pests, disease germs and viruses are not the basic cause of disease; they are nature's method of destroying unhealthy tissues. They are attracted to acid substances; all organisms in a state of positive health, including soils, are predominantly alkaline.

Fig. 17 Treehouse

There is little doubt that slugs are a symptom of acidity in the soil. Soil on which uncomposted farmyard manure has been spread is a breeding-ground for slugs. Therefore the first line of defence against them is a covering of lime. This not only sweetens the soil but also tickles their sensitive tummies, which they don't like. Wood-ash and soot perform similar functions. Watering the soil with liquid seaweed also has an alkalising effect. Calcified seaweed meal has the additional bonus of tiny shells, which also deter slugs.

Slugs also dislike strong smells. Many aromatic herbs, such as the var-

ious mints, tansy and balm, deter slugs and other pests and disease germs from attacking not only themselves but also their plant neighbours. The trouble with planting them between vegetables, however, is that they are extremely invasive; they are as vigorous as the worst weeds.

The best way to protect vegetable seedlings and transplants, I have discovered, is a herbal mulch, consisting of sprigs of aromatic plants and conifer twigs, which I spread between the rows. This not only deters slugs and other pests, but also screens the young plants from the wind, shades them from excessive sunlight and breaks the force of heavy rain. It also suppresses weeds and improves the soil, keeping it damp and preventing compaction. As it decays it feeds the young plants.

The herbal mulch also has a camouflaging effect. A bed of tender, young greenery can be irresistibly attractive to mischievous birds and mice, but, when surrounded by a many-coloured 'barbed-wire screen', the young plants are less conspicuous.

The final weapon in the campaign against slugs and other pests is constant hoeing. This not only breaks up lumps of earth, under which slugs love to hide, but also, by aerating the soil and removing obstacles to growth including weeds, hastens the young plants' growth. 'Keep them moving' is the watchword. The young plants soon acquire the vigour needed to enable them to resist pests and diseases themselves.

The final tip is, as far as possible, to choose plants with a natural immunity. Greedy slugs love brassicas which are greedy feeders, requiring lots of manure. But more and more members of the chicory-endive family are appearing in seedsmen's catalogues. These are attractive hardy plants with a wide variety of shapes and colours – some even develop red and variegated spears in the autumn – which originate from France and Italy. They are excellent substitutes for brassicas and lettuces throughout the year – and, from my experience, they are almost completely immune to slugs.

In the forest garden the main tasks are cutting back plants that seek to encroach on their neighbours, and pruning, so far as this is necessary. Even horticultural experts disagree as to how much pruning is really essential, apart from the obvious facts that dead and diseased twigs and branches should be cut out. Dr W E Shewell-Cooper, founder of the Good Gardeners' Association and a prolific writer on all aspects of horticulture, writes in *The Compost Fruit Grower*: 'Pruning should be regarded as a necessary evil rather than an operation that invariably does good. Pruning creates wounds, and wounds may easily be the open sesame to disease.'

The apple and plum trees in the large orchard which I had planted

when I first came to Highwood Hill have not been properly pruned for years, and yet many of them continue to give bumper crops. It is true that some of the fruit are undersized or blemished; they would be scornfully rejected by the eagle eyes of a supermarket manager. But how far superior in flavour, and therefore, I'm convinced, in nutritional value, to his glossy, uniform and lifeless specimens!

If one has the time and inclination to prune, it can be a very satisfying form of artistic creation. Most gardening books make it seem a daunting and bewildering task, but once you have mastered a few basic facts and principles, it is mostly commonsense.

The first fact one must learn is how each tree bears its fruit, whether on new or old wood, or, in the case of apples, whether they are spur-bearing or tip-bearing. Then, if one constantly bears in mind the aims of the operation, one can work out their application for oneself. The main aims are:

1. To allow sun, air and rain equal access to all parts of the tree or bush. The two best shapes for this are the pyramid and the 'open-centre' or 'goblet' shape.
2. To cut out dead, diseased, or weak unfruitful branches.
3. To prevent branches from rubbing against each other and so breaking their 'skins' and causing wounds, through which disease-organisms can enter.
4. To ensure regular bearing by seeing that there are roughly equal quantities of fruit-buds each year. If this is not done, one is liable to get gluts followed by barren seasons.
5. In the case of cordons, espaliers and fan-trained trees, to ensure they are trained according to the desired patterns of growth.

The basic rule of pruning is: 'If in doubt, don't'. It is far better to underprune than over-prune, especially in the case of plants in their first, tender years.

Once a year, when the herbaceous plants in the forest garden die down in the late autumn, the leaf-litter is supplemented by a deep layer of compost, straw and grass cuttings. This is necessary to build up the fertility of the soil and also to protect the plants and soil-organisms from frost. As in the natural forest, the soil should be permanently covered. Many vegetable gardeners are devotees of the 'bare fallow' during the winter. They dig over their beds roughly and leave the clods to be broken down by the frost, creating a fine tilth for seeding in the spring. But the frost also kills the living organisms, such as earthworms and beetles as well as myriads of microfauna, or drives them to take shelter deep in the subsoil. As these

are the main agents of fertility, the fine tilth, attractive though it may look, is largely deprived of nutrients, and these have to be added, in the form of compost, manure or fertiliser, at the time of seeding. Therefore, to my mind, the whole garden, AFG as well as forest garden, should be permanently covered throughout the year, either with plants or mulch. Mulching is not only less toilsome than hoeing and weeding, but also avoids the necessity of disturbing the soil structure. When the time comes for planting or seeding, all that is generally necessary is to rake off the mulch material and then rake over the soil underneath.

Chapter Eight

Water and No Water

There is evidence that this small farm was originally carved out of the Long Forest, which once clothed much of South Shropshire, by men and women from the mixed Celtic Christian monastery at Much Wenlock, which, in the seventh century, was presided over by St Milburga, daughter of the king of the Saxon sub-kingdom of Magonsaeta. Those pioneers certainly had an eye for water. Just below the circular earthwork which, I am convinced, was the site of their monastery, rises a spring, whose delicious water we still customarily enjoy, though it sometimes runs dry in times of drought. In the centre of the five-acre field, once called 'Middle Stocking', another spring rises from a perfect example of a 'knickpoint', the geological term for the lowest point of a hillside contour,

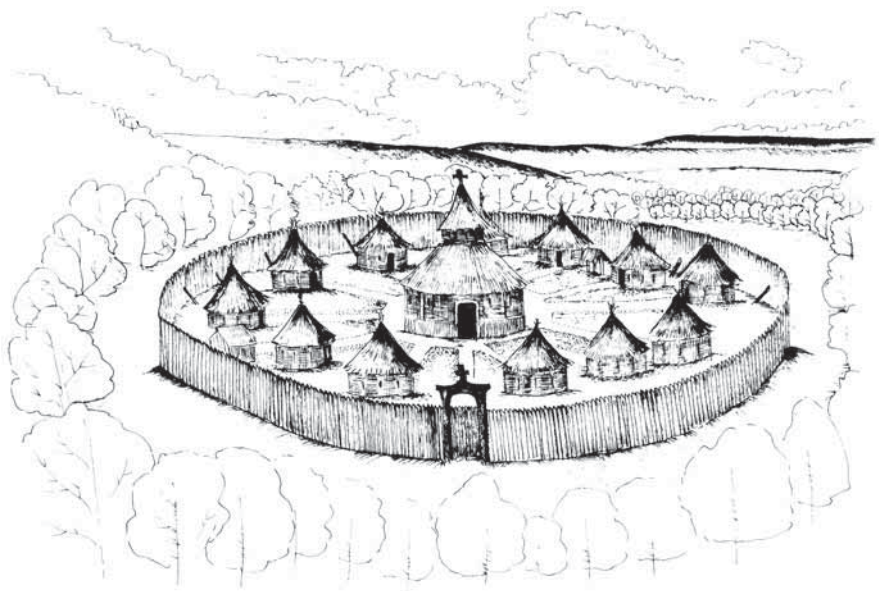


Fig. 18 Early Celtic Christian settlement

where the slope flattens out and where the groundwaters tend to meet to form a spring.

The keen eyes of P. A. Yeomans, the Australian mining engineer, farmer and conservationist, trained in landscape assessment, intuitively recognised in the 'knickpoint' the clue to his Keyline System of land reclamation. He renamed the 'knickpoint' the 'keypoint' and called the contour which passes through it the 'keyline'. The essence of his system is contour-ploughing parallel to the keyline with a non-inverting chisel-plough invented by himself. This has the effect of creating thousands of small channels, which cause the groundwater to spread across the slope instead of converging on the 'knickpoint'. The circulation of mineral-carrying water so brought about has the effect of releasing stores of fertility 'locked up' by soil compaction. The result, as Yeomans triumphantly proved on his farm at Yobarnie, New South Wales, can lead to the regeneration of land condemned by agricultural experts as 'irredeemable', after it had been baked as hard as concrete by a forest fire.

The Keyline System might have great significance for rainforest areas whose thin 'lateritic' soils have also been concretised by the twin forces of tropical sun and tropical rainfall, after the forest had been burnt to death to provide brief pastures for 'hamburger ranches'. In fact, Keyline would seem to provide a good chance of restoring those degraded soils and making them once more productive.

Yeomans developed his system into a comprehensive method of landscape architecture, applicable to any reasonably large undulating area. One refinement was the building of a series of small reservoirs along the contours, which could be temporarily dammed for sheet-irrigation. Another was the planting of shelter-belts of trees to distinguish the Keylines.

The idea of landscape design seems to be deeply rooted in the Australian consciousness, as the people's ancestors of not-so-long-ago were involved in opening up virgin territory. Bill Mollison, also an Australian, makes landscape design the centrepiece of his system of Permaculture, which he first conceived in the early 1970s at the same time as I was, quite independently, working out my own system of Organic Perennial Subsistence Agriculture or Ecocultivation. In *Permaculture One*, written by Mollison and David Holmgren, the authors say:

> Permaculture is a word we have coined for an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man. It is, in essence, a complete agricultural ecosystem... Perhaps we seek the Garden of Eden and why not? We believe that a low-energy,

> high yielding agriculture is a possible aim for the whole world.

I couldn't agree more.

In his book *Permaculture Two*, Mollison speaks with authority and passion about a problem which is dominating ever-growing sectors of the earth's surface: how to rehabilitate arid lands. Referring to Australia's vast empty spaces, Mollison affirms:

> I must state that, in my opinion, based on real examples sighted, the 'dead centre' is a myth. Not only will many important vegetables and tree crops grow in deserts, but the native vegetation, where not over-burnt or overgrazed, is, in itself, a great resource. Water lies close under-ground in many places... Growth in desert soil is phenomenal if water is available.

Listing a number of systems for trapping, conserving and utilising every available drop of water, he shows that a large number of trees and other perennial plants can be induced to grow in areas regarded as barren wastes. These include figs, olives and grapes, the three staples of arid and eroded areas in the ancient Mediterranean, as well as mulberries, date palms, oranges, lemons, carobs, mangoes, cashew nuts, jujubes and pomegranates.

In his great book *Permaculture: A Designer's Manual* Mollison describes in exhaustive detail numerous techniques for the reclamation of deserts and other arid lands – techniques which may well have to be applied in Britain and other European countries, as well as much of the rest of the world, if drastic steps are not taken to reverse the Greenhouse Effect.

Mollison paints a fascinating picture of the desert garden, as found in Central Australia, from which we in Britain may have much to learn if summer droughts continue. The garden is integrated with the house, for which it provides shade, shelter and climate amelioration. The roof may be covered with soil and planted with ice-plants, succulents and hardy desert species. This roof-garden cools the house in summer, when watered, and insulates it from winter cold. Trellised vines on the walls have a similar effect. Hedges of tamarisk, white cedar, paulownia or bamboo screen the house from cold winds. Arbours are formed adjacent to the house, in which strawberries, blackcurrants, gooseberries and herbs are grown, deeply mulched to retain moisture. Lean-to greenhouses provide winter greens, peppers and tomatoes, as well as spices and other flavouring plants such as ginger, turmeric and vanilla. All waste water from the

house is fully utilised. Sewage and 'grey' water from baths and sinks is conveyed to perforated pipes beneath the garden. Sludge from septic tanks is conveyed to planting holes, covered with soil and then planted with dates, figs, citrus trees or mulberries. If the house is situated on a frost-free hillside, tropical plants such as guavas, papayas and mangoes, sheltered by trees such acacias and paulownias, may grow successfully, being irrigated by wind-pump. If possible, the house is built near a water run-off area, such as a rock, and care is taken to see that all the water is absorbed into sand-plots or 'swales' – contour ditches designed to trap water which release it gradually into the soil.

The staple plants of the desert garden are drought-tolerant species, able to survive on minimal watering, such as dates, olives, avocados, apricots, bananas, sweet potatoes, cucumbers and melons. However, most tropical and temperate vegetables can be grown in small beds, soaked every 3-10 days and shaded by slats, vines or leguminous trees. The legumes inject nitrogen into the soil. Other companion plants are used, including marigolds, gladioli and wallflowers, so that the desert garden can be gay with colour.

Many irrigation devices have been used in the past – and are still used – to ensure that gardens and orchards in arid lands are places of beauty and fecundity. A notable example is provided by the elaborate water-works created by the Moorish cultivators in Southern Spain, which included dams, aqueducts, reservoirs, sluices, tunnels and siphons.

In the Far East many upland areas have been terraced with incredible skill, to ensure that every available drop of water is utilised for growing crops. Alfred Russel Wallace, the famous Victorian biologist, who conceived the theory of natural selection independently of but contemporaneously with Charles Darwin, recounts in his book *The Malay Archipelago* his astonishment at the system of cultivation which he discovered on the Indonesian island of Lombok, from which at that time almost all Europeans were excluded:

> I rode through this strange garden utterly amazed, and hardly able to realize the fact that in this remote and little-known island... many hundreds of square miles of irregularly undulating country had been so skilfully terraced and levelled, and so permeated by artificial channels, that every portion of it can be irrigated and dried at pleasure... Here were luxuriant patches of tobacco; there cucumbers, sweet potatoes, yams, beans or Indian corn... The banks which bordered every terrace rose regularly in horizontal lines above each other, sometimes rounding an abrupt knoll and looking like a fortification, or sweeping round some

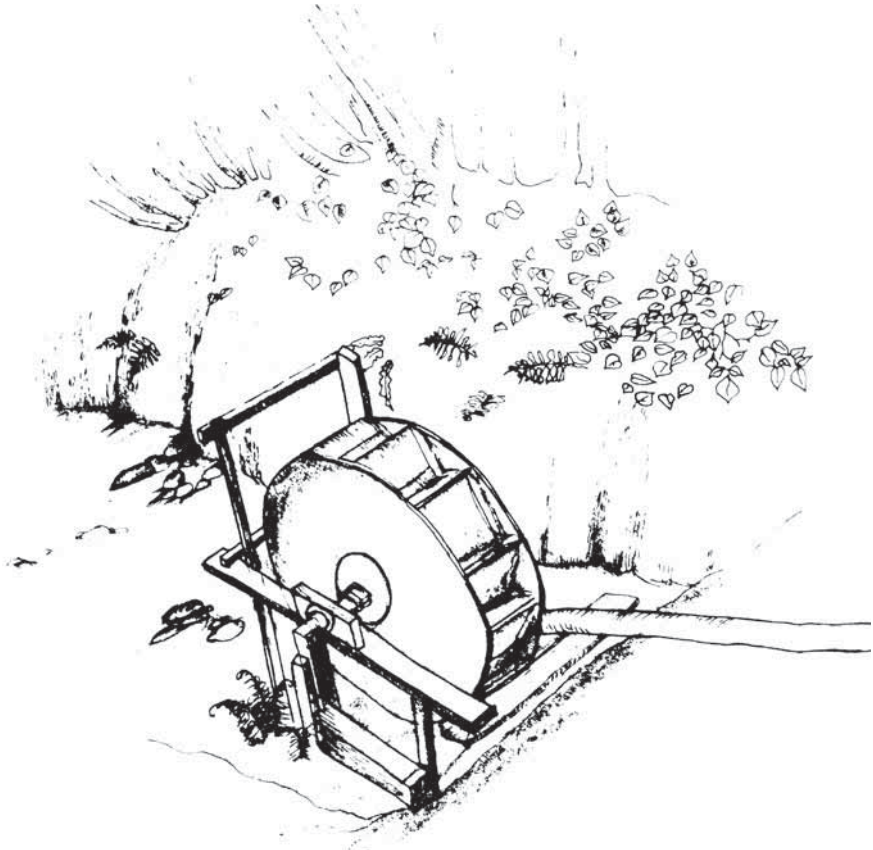


Fig. 19 Water-wheel for irrigating bog-garden

> deep hollow and forming on a gigantic scale the seats of an amphitheatre. Every brook and rivulet had been diverted from its bed, and instead of flowing along the lowest ground were to be found crossing our road half-way up our ascent, yet bordered by ancient trees and moss-grown stones so as to have all the appearance of a natural channel, and bearing testimony to the remote period at which the work has been done. As we advanced further into the country, the scene was diversified by abrupt rocky hills, by steep ravines, and by clumps of bamboos and palm trees near houses and villages; while in the distance the range of mountains of which Lombok peak, eight thousand feet high, is the culminating point, formed a fit background to a view scarcely to be surpassed in human interest or picturesque beauty.

A system of water control that was developed over 2,000 years ago in one

of the harshest arid areas in the world, that of the Negev Desert, has been successfully revived by an Israeli professor, Michael Evenari. The system was originated about 200 BC by the Nabateans, builders of the famous rock-hewn city of Petra. It comprises an ingenious complex of run-off channels, small dams, trenches, terraces and cisterns, designed to gather up the meagre rainfall – three to four inches a year – and concentrate it in a single growing area. Evenari refined the system to the extent that he created microcatchments, each designed to irrigate a single tree or bush: olive, pomegranate, peach, apricot, fig, almond, grapevine or saltbush (used for fodder). Yields from this modern version of an ancient system were extraordinarily high, and so impressed a German relief group that they translated the system to a heavily eroded area of Bolivia. There, in a strange 'lunar' landscape of gullies and dome-shaped mounds, they recreated Evenari's microcatchments into forms that were nicknamed by the local inhabitants *medias lunas* – 'half-moons'. Each of these comprises a small rainfall collection area, with an earth wall on the downhill side to prevent erosion; in each two saplings are planted: leguminous trees bearing high-protein beans, intended to provide food, fodder and firewood, while improving the fertility of the soil by injecting nitrogen. The retention of moisture in the soil has had the effect of attracting the colonisation of wild plants, and it is hoped that a train of ecological succession has been set in motion, the culmination of which will be a dense climax forest, like that with which the area was originally clothed.

More and more it is being recognised that the tree provides the masterkey to the reclamation, fertilisation and regeneration of arid lands. Where large numbers of trees are planted there is no need for elaborate irrigation schemes. Such schemes, with their associated big dams, often involving the drowning of hundreds of square-miles of fertile land, may lead to ecological disaster. The irrigated soils tend to become heavily salinated and therefore incapable of growing crops, while the reservoirs become silted up and lose their utility. Trees, on the other hand, with their complex root-systems, create their own irrigation channels in the soil, through which pass pure life-giving streams of water, laden with subsoil minerals, which nourish other crops.

No country in the world understands the value of trees as does China, which, in recent decades, has planted countless millions for the reclamation of deserts, for shade, shelter and windbreaks, and for the control of water, to halt the cycle of floods and droughts which has been one of the banes of China's history.

Trees can be used not only for the restoration of arid lands but also for the prevention of flooding. One of the main causes of floods in many

countries, not least Britain, is the felling of forests and the draining of marshes in upland catchment areas where most rivers and streams have their sources. This means that there is little absorption of precipitation in those areas. Storm water races down the denuded slopes, and rivers and streams become suddenly swollen and burst their banks.

Forests not only make rain by transpiring groundwater into the atmosphere, but they also absorb rain through their roots and then release it gradually into the groundwater system, so that 'flash floods' are rare in a forested area. The simplest and most effective way to stop flooding, therefore, is to restore tree-cover to upland catchments. Marshes in the same areas could, I suggest, be transformed into economically viable wetland permacultures.

A large and very remarkable 'forest garden' called *Sol y Sombra* (Sun and Shade), including some 150,000 economic trees and shrubs, has been created by Beth and Charles Miller high up in the hills near Santa Fé, New Mexico. In this arid area rainwater is harvested by more than 100 'swales'. Sewage and 'grey' water is treated by a reedbed system, comprising four-gravel beds and two ponds, planted with reeds, rushes and bog flowers.

In recent years a number of systems for treating waste water by natural, biological techniques have been developed in many parts of the world. These systems are highly compatible with agroforestry principles:

1. They make use of plants and bacteria to purify and detoxify potentially harmful material, transmuting it into useful resources, including energy and fertiliser.
2. They help to conserve the environment, creating beauty and attracting wild-life.
3. They are largely self-sustaining, requiring minimal maintenance.

A feature incorporated into many of these systems is the 'flowform', a series of concrete basins carefully sculpted to impart rhythmic, pulsing movements to the water, which, it is claimed, help to oxygenate it and enhance its ability to support the purifying organisms.

The reeds and rushes, which often play a key role in water treatment systems, have many traditional uses. Richard Mabey in his *Plants with a Purpose* (Collins, London, 1977) writes: 'It is the common characteristics of the stems of reeds, rushes and sedges that make them so useful and adaptable. They are long and straight, always lightweight and often hollow. The grouping of tough fibres round the outside of the stems makes them pliant, durable and easy to work. They are ideal, therefore, for weaving or bunching into hardwearing articles like baskets or mats.' 'In Nevada,' Mabey declares, 'the Paiute Indians weave rush cradleboards for

their babies and, with a real understanding of the natural waterproofing of a plant that spends its life up to its knees in the wet, makeshift boats.'

The reedmace, *Typha latifolia*, often erroneously called 'bulrush', is a plant with a multitude of uses. The familiar long brown spiky flowers, which give it its American name of 'cattail', can be cooked and eaten. The seeds are also edible and yield an edible oil. The pollen is a first-class source of protein, and the young shoots can be eaten like asparagus. The core of the rhizome contains more carbohydrate than potatoes and as much protein as maize or rice. Of all wild plants, the reedmace has been described as the most useful emergency food source. But the leaves and stems also yield fibres that are used for weaving and have potential value for paper-making. Mexican studies have shown that woven reedmace leaves, when coated with plastic resins, are as strong as fibreglass.

At this time when the threat of the Greenhouse Effect looms over the lives of all of us, a special study should be made of temperate plants which require a minimum of watering, comparable to the studies made of drought-resistant plants in the tropics. The common characteristics of such plants seem to include:

1. Small or waxy leaves which reduce evaporation;
2. Hairy leaves that retain moist air, keeping them cool;
3. Hollow stems, used for storing water (onions and thistles);
4. Ability to survive in shallow grassland or on rocky slopes (thyme, marjoram and yarrow).
5. Deep roots, which extract water from the subsoil.

Among tactics which I employed to combat the severe drought in England in 1995 were heavy mulching to preserve the moisture in the soil and drastic pruning and weeding to minimise stress in the more valuable plants.

Chapter Nine

Stored up Sunshine: Energy Yesterday and Tomorrow

Ironbridge Gorge in Shropshire was the birthplace of the Industrial Revolution. Little can the Quaker ironmasters who originated it have foreseen the devastating effects on the whole world of the forces that they set in motion, the powers that they unleashed.

If the appalling damage that industrialism has done to the environment is to be reversed, a great new comprehensive initiative must be set afoot, comparable in vitality and intensity to the Industrial Revolution itself. But all true progress is a spiral, not a straight line; the new must grow out of the old and include elements which, to some extent, are reversions to older patterns. The Post-Industrial Society, which some far-sighted 'Greens' proclaim, can find ideas and inspiration from a study of the processes which led to our own present problems.

Before the Industrial Revolution, and for some time after, Shropshire, with its many streams and rivers, had, like many other parts of Britain, relied mainly on water as a source of power. Watermills had been used for grinding corn, for fulling (shrinking) cloth, for sawing wood, for making paper and for blowing bellows in blast furnaces. A number of old mills and mill-houses still exist. Anyone with an eye for landscape and some knowledge of milling techniques can detect signs of the ponds and weirs, dams, leats and millraces, which the milling operations entailed. Regular, disciplined activities were required to keep the often elaborate milling landscapes in good order. As mills were sited at regular intervals on almost every waterway, however small, the water-control network must have done much to prevent flooding.

When my brother and I gave up livestock farming, we spent some six months thoroughly exploring the South Shropshire countryside in our ancient Land Rover and on foot. We saw many relics of Shropshire's industrial past and talked to some people who remembered them in operation. What we saw and heard gave much food for thought.

Bouldon is one of Corvedale's many dead or shrunken villages. It lies

about five miles to the east of Highwood Hill, on the far side of Wenlock Edge and on the Roman road which crosses my land. It contains an old watermill, with an impressive outside wheel below a stretch of grass which was once the millpond. About half a mile to the east, on the Clee Brook, is a high weir, like a mini-Niagara. The farmer who lives behind the mill-house told me that he could remember the wheel being used to grind corn; before it could operate, the water had to be switched from the weir and conveyed along an elaborate system of leats to the millpond. Before it was used to grind corn, Bouldon mill had served as adjunct to a blast-furnace and as a papermill. Now this once important industrial village is a tiny rural backwater. Still more remarkable is the total ruralisation of the Willey estate near Broseley, which once belonged to my mother's ancestors, the Lacons, and which, during the seventeenth and eighteenth centuries, was an important arms manufacturing area. At Willey Wharf on the Severn the world's first ironclad ship was launched. Now Willey is mainly remarkable for its magnificent trees and for a small remnant of the once extensive primaeval Shirlett Forest. The former furnace ponds have been converted into ornamental lakes.

Many people, like myself, would like to see parts (at least) of the former mill-network restored; not perhaps for its former purposes, but as a sustainable, clean, non-polluting means of generating electricity: a system which, far from contaminating and defacing the landscape, would, with the assistance of trees, help to maintain the circulation of water, which is the lifeblood of the landscape.

I don't suggest that electricity generated by waterwheel should be fed into the National Grid but it is a possible source of light, heat and power for small communities striving for self-sufficiency. Other, more sophisticated mechanisms, developed within the last two centuries, should also be considered, provided that adequate water is available. These include the turbine, the hydraulic ram, and the air compressor.

While the principle of the turbine was originally conceived by Hero of Alexandria in 100 B.C., the first effective models date back to the middle of the last century. One of the earliest, most primitive versions, called the 'hurdy-gurdy', was developed by miners during the Californian Gold Rush of 1849. It consisted of a simple pulley with flat plates bolted to the rim. The pulley was caused to spin by water from above dropping on to the plates. In the succeeding 140 years many types of turbine have been developed, using propellers and other devices, to provide power for grain-mills, pumps, sawmills, metal-working machinery and, above all, to generate electricity. They vary in size from monstrous units requiring big dams and incorporated in giant hydro-electric schemes to tiny 'micro-

hydros' that can be assembled by any DIY enthusiast for home generation.

The hydraulic ram, a kind of 'water-hammer' used to raise water above the height of its source, was invented by John Whitehurst, a Cheshire brewer, in 1772. But the version which is still widely used today owes its effectiveness to the invention in 1798 of the automatic pulse valve by Pierre Montgolfier of hot-air balloon fame. While the ram is most commonly used as an automatic, low-maintenance pump for supplying water from hill-streams to remote farmhouses, it has also been used for compressing air for rock-drills.

A still simpler device than the ram, with no moving parts, the hydraulic air compressor or 'trompe' was first developed in mediaeval Catalonia to act as an automatic bellows for an iron furnace. For a brief period it was revived at the beginning of the present century in the United States. The National Academy of Sciences in Washington in *Energy for Rural Development* (1976) suggests that it should be 'resurrected for further study and possible use in hilly terrain where ample water is available. The ability of the device to operate day and night, with its simple storage of energy in the form of compressed air in tanks or caves, makes it an interesting and potentially fruitful problem to investigate. The compressed air could be piped to sites to drive reciprocating engines or turbines that, in turn, could power production machines or electric generators.'

Of special significance in the agroforestry context is the use of biomass for energy production. 'Biomass' is the generic term for all forms of organic, carbon-containing material, living or dead, including garbage and sewage.

A number of methods can be employed for extracting energy from biomass.

1. *Burning*. The simplest method, employed since before the dawn of history, is the burning of wood, peat and cattle dung. Incredibly, this is the principal or only method still used for cooking and heating by over half the world's population. It is extremely inefficient, owing to the large amount of heat lost in the air.
2. *Pyrolysis*. This involves baking the raw fuel in the absence of air. It can produce combustible solids, liquids or gases. Charcoal has been made by this method for hundreds of years.
3. *Gasification*. The heating of biomass under pressure in the presence of air and steam to produce combustible gas.
4. *Pelletization*. The manufacture of 'briquettes' from materials such as sawdust to produce coal substitutes.

5. *Bacterial digestion*. The production of methane or biogas from sewage, garbage and organic wastes generally.
6. *Fermentation*. The production of ethanol, butanol and acetone by the processing of plants with high contents of sugar or starch, such as pineapples, potatoes, maize, cassava, sorghum, sugar beet and sugar cane.
7. *Extraction of energy-rich products from plants*; such as palm-oil and olive-oil.

Large quantities of ethanol have been produced over the years from Brazilian sugar cane plantations. As a motor-fuel, ethanol can be used in conjunction with petrol in a proportion of about one to five, but where engines have been re-designed, hydrated ethanol can be used alone. However, ethanol can cause corrosion of some metal alloys and deterioration of some plastics.

Biogas is an energy source very extensively used in a number of countries, notably China. Millions of Chinese peasants use small DIY digesters to convert human, animal and plant wastes for home cooking, heating and lighting. The residue is a virtually odourless, disease-free liquid used as fertiliser.

The special importance of biogas lies in the fact that it is a way of utilising objectionable materials which are available everywhere and which, in most countries, are not utilised, as they should be, for creating energy, but are *disposed of* in ways that seriously pollute the environment, especially inland waterways and the oceans.

In the natural forest *all* biomass residues are recycled to form compost, which feeds and energises the plants.

The raw materials of biogas can include, not only human, animal and plant wastes, but also the most objectionable and troublesome of weeds, such as water hyacinth which in many tropical and subtropical regions clogs vast areas of inland waterways and lakes.

In *Making Aquatic Weeds Useful* (National Academy of Sciences, 1979) it is stated:

> In a pioneering effort of great significance, researches at the National Aeronautics and Space Administration (NASA) are working on converting water hyacinth and other aquatic weeds into a biogas rich in methane. Methane is the main ingredient in natural gas, which is used worldwide as fuel and is a major item in international trade. The recovery of fuel from aquatic weeds... has interesting implications, especially for rural areas in developing countries. As many developing nations

> have an apparently inexhaustible supply of aquatic weeds within their borders, this potential energy source deserves further research and testing. Aquatic weeds are converted to biogas by capitalizing upon one of nature's processes for decomposing wastes – decay by anaerobic bacteria. Methane-producing bacteria are common in nature (for instance, in the stagnant bottom mud of swamps, where they produce bubbles of methane known as 'marsh gas'). If they are cultured on water hyacinth in a tank, sealed to keep out all air, they produce a biogas composed of about 70 per cent methane and 30 per cent carbon dioxide. The high moisture content of aquatic weeds is an advantage in this process. It is needed for fermentation. This is one method of aquatic weed utilization that does not require dewatering – a big advantage.
>
> Based on NASA's findings, it appears that the water hyacinth harvested from one hectare will produce more than 70,000 cubic meters of biogas. Each kilogram of water hyacinth (dry-weight basis) yields about 370 litres of biogas with an average methane content of 69 per cent and a calorific (heating) value when used as a fuel, of about 22,000 kJ/m^3.

These amazing figures, based on just one of the many possible ingredients of biogas, indicate its vast unused potential.

If mineral-neutralising aquatic plants were added to city sewage, that would probably be the answer to those who object that it is unsuitable for conversion into fertiliser, not only on account of its content of heavy metals and pernicious micro-organisms but also because it contains harmful industrial chemicals.

Another water-loving plant, the willow, is being grown in large numbers in Sweden, Northern Ireland and the Somerset levels as a quick-maturing source of biomass fuels. Willows do particularly well in Ireland's moist climate and boggy soils and leading horticulturalists believe that 'energy forests' could do much to re-vitalise the country's rural economy. The original aim of research initiated in 1973 at the Horticultural Centre at Loughall, Co. Armagh, was to find 'superwillows' that, by coppicing, would form a regularly renewable source of pulp for paper-making. But the energy crisis of 1974 caused the research team to change their priorities. They came to the conclusion that willows could form a valuable source of relatively cheap energy in the form of chips, pellets or briquettes. In a three-year trial with greenhouse tomatoes, it was found that the cost of heating with willow-chips was only one-third the cost of conventional fuel-oils. Using trees carefully selected by Long Ashton Research Station, Bristol, it was found that yields of up to twenty-five

tonnes per hectare per year could be achieved. Other applications for the willows include fuel for domestic wood-burning stoves, ethanol to replace lead as a high-octane enhancer in petrol, and viscose to be used in combination with flax or other fibres in Northern Ireland's textile industry.

From 'Wind in the Willows' it is a short step to aerogenerators.

For nearly a thousand years windmills played an important part in the economy of Britain and other European countries. It has been reckoned that a single traditional windmill used for grinding corn, with a 25-metre rotor made from wooden spars and canvas, could do the work of more than 200 people. Towards the end of the last century much research was done into the possibility of improving windmill efficiency, and in the 1890s Denmark successfully produced windmills designed specifically for the generation of electricity. By 1908 several hundred small wind-power stations were in existence, each one capable of producing 5-25 kW. In the 1930s the Soviet Union built the first large wind-turbine, capable of generating up to 100 kW. In the following years a number of large experimental machines were built, but it was not until the energy crisis in the 1970s that governments and other official bodies began to take a serious interest in aerogenerators. In 1975 a prototype 100 kW wind-turbine began operation at Sandusky, Ohio; it had been designed by NASA, the National Aeronautics and Space Administration. The first multi-megawatt wind-turbine in North America was commissioned in 1979 at Boone, N. Carolina. Today a wide array of wind-generators is available, experimental and practical, of all shapes and sizes, suitable for large-scale schemes or for domestic use. The Rutland Windcharger, which I had installed to supply light for the small cabin which houses my craft-museum, is a highly efficient, small but tough and durable machine, mass-produced at Corby, Northamptonshire. It is extensively used in several parts of the world as a source of power for light, radio, TV and other utilities in caravans, boats, farms, remote buildings and even an Antarctic research station. For remote sites, Northumbrian Energy Workshop Ltd of Hexham supply a composite package comprising wind-generator, micro-hydro turbine and photovoltaic module.

The photovoltaic module or cell is one form of 'active' solar device for converting sunlight into electricity. The first modules were developed in 1954 at the US Bell Laboratory during research into silicon chips. Basically, all that is involved is a single crystal silicon cell which generates electricity when exposed to sunlight. Such cells were used to power instruments in the early satellites.

A form of solar generator that is more familiar to the general public is the 'panel', used to heat water, which can now be seen on the south-fac-

Fig. 20 Rutland Windcharger

ing roofs of many houses. The panel is usually made of stainless steel and faced with glass. The inside surface is usually matt black, designed to absorb solar radiation and transform it into heat. The heat is transferred from the surface of the panel into cavities or pipes within the panel, filled with air, water or an oil-based fluid. The liquid or air is passed through a normal plumbing circuit into a spiral element, which heats the water in a well-insulated storage tank.

A type of solar generator which would fit well into a permaculture scheme is the solar pond, first developed in Israel. A typical pond is two to three metres deep with conical sides and a flat, blackened bottom. It is filled with layers of brine of increasing concentration, the densest at the bottom containing as much as twenty per cent salt. Sunlight absorbed by the brine can yield temperatures as high as 100 degrees centigrade. Loss of heat is prevented by the salt gradient, which suppresses thermal convection, and ponds can effectively store heat for months. The heat is removed by drawing brine from the bottom of the pond through heat exchangers or by circulating a heat transfer fluid through submerged coils. In Israel solar ponds are used to drive heat engines for the production of electricity. They can also be used for district heating schemes.

'Passive' solar heating relies on the architectural design of a building, which is so devised as to capture, store and distribute the sun's radiation. The ancient Greeks were the first to develop solar architecture, designing buildings with open, south-facing porticoes, which permitted low winter sunshine to penetrate to the living-rooms, while providing shade in the summer. The heat was absorbed by dark stone floors and thick masonry. Buildings were insulated to prevent draughts. The Greeks actually built several solar cities. The Pueblo Indians of the South-West United States also built several solar hill-towns in the eleventh and twelth centuries. One of the most sophisticated was Acoma, which had three terraces running east to west, built in tiers for maximum exposure to the winter sun. The roof of each tier was layered with straw and other materials to insulate the houses from the full blaze of the summer sun.

In the hills of Mid-Wales today, David Huw Stephens is developing a solar village called Tir Gaia, at Rhayader. The design of the model 'Survivor House' is fascinating in the extreme. It combines both 'passive' and 'active' solar features. On the roof is a greenhouse, with rainwater tanks to provide water for the plants and house. The tanks will absorb radiant solar heat during the day and help to keep the greenhouse frost-free at night by re-radiation of the heat. On the south side of the house is a solar panel to provide hot water, and below the foundations are water cylinders to transfer heat from the solar panel to the soil and thus create a subterranean heat-store. Large south-facing double-glazed windows admit solar energy to the main living-room, which is on the first floor. The walls have absorbent surfaces which convert solar radiation into convecting warm air. North-facing walls are 'super-insulated' and the downstairs bedrooms have insulating shutters which are closed at night to reduce heat loss. Outside the front-door, referring to the produce of the roof-top greenhouse, is a notice: 'Home-grown Bananas'.

A remarkable and comprehensive display of sustainable and non-polluting devices for producing and saving energy can be seen at the Centre for Alternative Technology, Machynlleth, Mid-Wales.

Chapter Ten

The Thinking Hand: Skills of the Craftsman

A Permaculture/agroforestry scheme, as a holistic organism designed to sustain and foster whole human beings, should incorporate craftwork of various kinds, so that it supplies as many as possible of the diverse needs of those who run it. In the traditional rural community there were no 'closed shops', no union rivalries, but there was complete integration between craftsmanship, husbandry and forestry. The true peasant was a versatile all-rounder, who could turn his or her hand to almost any country task and was capable of facing up to almost any emergency. H. J. Massingham, in *The English Countryman* writes: 'From times immemorial, the practice of a craft was the part-time or seasonal occupation of the husbandman, while the craftsman almost invariably had a 'close' or holding of his own, the hurdler an acre or less of coppice, the basket-maker an osier-bed, the straw-plaiter a plot of corn, the potter a stake in the claypit, the mason or waller a share in the quarry.'

To my great regret, I have never found time to practice any rural crafts – writing and teaching have been my crafts – but I have been closely associated with the work of craftsmen who have contributed to my farm and garden. Whenever possible, I have employed skilled private individuals from the neighbourhood or further afield in Shropshire, rather than faceless firms in distant towns or cities. At the same time, in an incessant urge to sink roots ever more deeply into my ancestral countryside, I have tried to seek out traditional crafts and vernacular styles throughout the county.

The main focus of my studies has been two highly contrasted regions: Ironbridge Gorge and Shropshire's 'Middle West', the wild country immediately adjacent to Wales, between the Stiperstones with their strange rock outcrops and the Long Mountain. Both, in their entirely different ways, have the stimulating characteristics of the Frontier; both are interfaces between different outlooks, patterns of thought and ways of life. While the 'Middle West' is where the pragmatic Saxon meets the intuitive and emotional Celt and Iberian, Ironbridge Gorge is an outpost of a well

wooded and still deeply rural countryside in collision with Telford New Town, a western extension of the industrial Midlands. And, since challenge-and-response is one of the basic essentials of creativity, the psychological conflicts involved are, I believe, more conducive to new initiatives than more settled modes of thought and living.

The 'Wild West' has a singularly archaic atmosphere. It contains Shropshire's 'Stonehenge'. the stone circle called 'Mitchell's Fold', as well as a Bronze Age trackway called by the Welsh name Yr Hen Ffordd (the Old Road). Round a wooded eminence in the foothills of the Long Mountain are the remains of the dead town of Caus, which are little known even to Salopians. Named after Caux in Normandy, the ancestral home of the dominant mediaeval family of Corbet, the town was burnt to the ground during a Welsh rebellion in the fifteenth century and finally abandoned in the seventeenth century. A few remnants of the Corbet stronghold, including a gigantic well, can still be disentangled from the undergrowth.

In the south of this area, below the site of a stone-axe factory on the slopes of Corndon Hill, and right astride the English-Welsh boundary, live Rita and Robert Acton, expert craftspeople who, every January, used to cut down and take away the 'wands' from my osier coppice – for basketry.

Basketry is believed to be the earliest of all crafts. The first human artefact may well have been a simple container, formed of plaited twigs, stems, creepers, or vines and used to carry berries, nuts, roots and other edibles gathered by the forest wanderers. A later development would have been a primitive loom used to weave forest fibres into skirts and cloaks to protect naked bodies from the elements. Thus basketry is supposed to have led to the invention of weaving.

The use of baskets should be regarded as one of the hallmarks of responsible, eco-friendly living. A well-made basket is a strong, durable, long-lasting container which, in the past, was used for most of the purposes for which throwaway cardboard, plastic and wood-strip containers are used today. Basket-making is a wholly non-polluting manual skill; no basket-making machine has ever been devised. On the other hand, our present container industry involves the wholesale destruction of trees, massive pollution and a colossal waste-disposal problem. When, after years of use, baskets eventually rot, they do not harm the environment, as does plastic, but, like other forms of biomass, gently disintegrate to form life-giving compost. A single basket will outlive 1,000 cardboard boxes. Durability is one of the outstanding characteristics of good hand-craftsmanship.

Rita Acton, a large, robust countrywoman with a ruddy face beaming with health and good humour, is both a skilled basket-maker – as is her

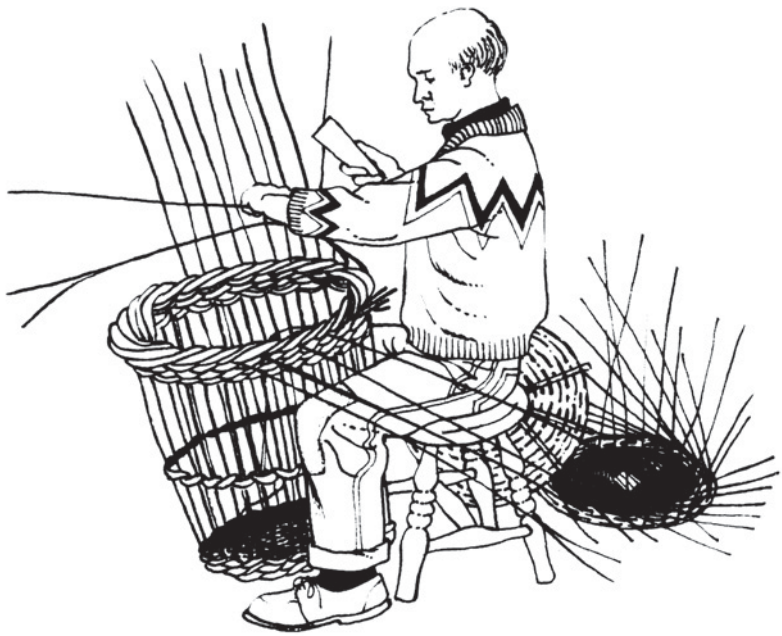


Fig. 17 Basket-making

husband Robert – and also an expert in all branches of home textile production, from the cultivation of flax to spinning, weaving and lacemaking. The creation of linen goods seems to call forth her keenest enthusiasm and brings out to the full her innate artistic talents. A linen smock which she had fashioned through every stage of growth, from the sowing of the flax-seed through all the arduous and complex stages of processing the fibres, is the most exquisite garment of its kind I have ever seen. A garment, moreover, that could endure, literally, for centuries. In the old days, farm-labourers' smocks would be handed down from father to son to grandson. Ancient smocks can still be seen in museums.

Rita gave me a graphic description of all the stages of flax processing, from pulling the plants – they should not be cut – to 'retting' them, that is, allowing them to rot in water or dew; to 'scutching', that is fracturing the woody core, and 'heckling', that is, combing out the fibres until they become filaments as fine and soft as silk.

The retting process involves fermentation, and the plants, if placed in troughs of water, can become so explosive that they throw off heavy blocks of wood laid on top of them to keep them down. Flax has been described as an 'aristocrat' among plants with an imperious will of its

own, which influences both the way it is treated and its ultimate use and form. The earliest indications of its use for fabric-making come from the prehistoric Swiss lake villages.

H. J. Massingham was a passionate admirer of traditional craftsmanship, and much of his most inspired writing was devoted to vernacular architecture and the lives and work of country craftsmen and craftswomen who, with grit and determination, managed to maintain their chosen vocations despite the pressures of industrialism. Owing to the disruption of cotton imports during the Second World War, the British government encouraged a revival of flax-growing in the southern counties, and Massingham enthusiastically supported the flax campaign. His masterpiece *This Plot of Earth* contains a vivid and memorable description of a flax workshop in Wiltshire, presided over by a friend who shared his sympathetic understanding of craftsmanship and its wider and deeper implications.

In this workshop, with its happy, co-operative family atmosphere – it was mainly staffed by members of the local farming community – utility was integrated with beauty, manufacture with art, mechanical work with field work. Almost all the work relied on manual skills; a few small 'Intermediate Technology' machines aided and supported the handwork, but did not supplant or dominate it. Massingham's account is so overwhelmingly attractive as a living preview of work as it should be in a decentralised, ruralised, post-industrial society, that I must quote from it at length.

> It was certainly the oddest kind of factory; the people in it moved in a leisurely fashion; they conversed as at a social gathering; they remained individuals; there was nothing automatic in their actions; no hurry; no regimentation and no clock... The key to the whole was the Scutching Room... I saw the girls scutching (dressing) the flax... and noticed something which gave me the clue not only to what kind of factory this was but to the philosophy of life underlying its operations. This was nothing more than a peculiar swing and curve of the arm when the strick of flax was applied to the ends of the lathes attached to the wheels. Some of the girls were doing their scutching better than others and one was doing it superbly. I could not but link this in my mind's eye with two things I had already seen – the curve of the flax-heads in the field and a magnificent round stack in the factory yard.
>
> But the culmination of this strange and beautiful affinity between the way the flax grew in the fields and the way the girls were handling it was

> when I saw two girls dressing the flax. One of them was the champion at the hand-scutching. I do not pretend to be able to give an impression of this carding of the tresses of the flax between the fingers. The looser gossamer-like strands are teased out, and there is a peculiar turn of the wrist and toss of the arm when they rejoin the cascade of lustrous flax fibre from the other hand. The levelling and evening are done by a caressing motion of the fingers. All I can say is that the action or series of actions was like a figure on a Greek vase. *Noblesse oblige*: the flax itself ordained this art and the genius of the Director had transformed the factory to a gallery where girls made gestures as in a sculpture or painting and quality and skill were the final arbiters... The greater the skill, the finer the grace...
>
> The wise Director, being a husbandman himself, is fully aware of the organic need for the correlation between field and workshop. He gets the workers out into the fields as often as he can, not only for their *health* but the *wholeness* of this essentially country industry. The steepled flax is set up in parallel lines of sheaves... But something more there is. That is the girls moving between the aisles in bright tops and dungarees and turning each steeple so that wind and sun can reach the straw. The action has all the elements of ritualism...
>
> With the conviction that all genuine husbandry and craftsmanship are an art like any other, the Director is using... the machines to build up a hierarchy of function of which mechanical work shall be the basis and the hand-skills the ultimate purpose... This is surely the beginning of man's mastery over the machine without which no civilization can or deserves to survive.

At the northern edge of Wenlock Edge stands the small market-town of Much Wenlock, which has been a centre of regional culture for some 1300 years, by virtue of its priory and two remarkable women who made their homes there: St. Milburga, who brought the civilising influence of Celtic Christianity to much of West Mercia, and Mary Webb, the novelist and poet, whose writings unlocked the heart and springs of Shropshire's deep rurality for millions of people in Britain and abroad. Surviving lists of mediaeval and Tudor craftsmen and musicians underline the creative vitality of this small town in the past. They include masons, thatchers, dyers, embroiderers, goldsmiths, pewterers, glass-makers, potters, pipers, fiddlers, harpers, drummers and organists. The wealth of skilled craftsmen in Much Wenlock and other towns and villages in the district

was a major factor in the early success of the Industrial Revolution.

The New Town of Telford is being built on the site of the Shropshire coalfield. All the seams had been worked out and many of the industries associated with it had closed down. The result was a landscape with large areas of derelict semi-wilderness, spoil heaps covered with scrub and extensive stretches of natural woodland. On the southern edge of this landscape, lining the River Severn, are the enormously impressive and multifarious remains of the world's first industrial area, scheduled by UNESCO as a 'World Heritage Site'. At the western end of the Gorge, in the town of Coalbrookdale, which is Where it All Began, is a new initiative, masterminded by a dynamic Welshman Gerwyn Lewis, to manage and make the best possible use of the Telford woodlands. Called the Green Wood Trust, its headquarters occupy the Victorian buildings of Coalbrookdale railway station and an attractive half-timbered building called 'Rose Cottage'. With the motto 'our feet in the past but our sights on the future', Lewis is reviving a number of traditional woodland crafts, striving to improve their techniques and finding practical outlets for them in tune with the needs and fashions of the present age. In his opinion, the potentialities of the forest have been grossly undervalued. When a forest is felled large quantities of 'lop and top' are simply wasted. These are among the raw materials of the many craft-products that Lewis sponsors and whose construction techniques he teaches.

At the centre of the station site is a small building which immediately struck me by its unusual beauty. It is is a mediaeval-style 'cruck' barn with slatted walls, made from local oak, ash and sweet chestnut. (In 'cruck' construction the roof is supported, not by the walls, but by two large, curved timbers meeting at a point). Over the doorway is a characteristic piece of traditional Shropshire wood sculpture, showing the 'Green Man', a Celtic woodland deity, surrounded by branches and leaves. The barn is used for courses and exhibitions. Among woodland crafts taught or demonstrated at the centre are charcoal burning, the making of chairs, hurdles, bowls, rakes and spoons, wood-sculpture and the use of the pole-lathe, a very ancient implement, powered, not by machinery but by treadle. The centre has also revived a craft going back to prehistoric times, which survived tenuously through the ages in Shropshire and Mid-Wales. This is the making of the coracle, a small, circular, portable boat. I suggested to Gerwyn that coracles might be useful for expeditions exploring forested areas with numerous rivers and streams, like Amazonia, as they could be carried all day, like rucksacks.

An important long-range aim of the Trust is to market DIY timber house-building outfits, which could be assembled by semi-skilled labour,

enabling people to build their own homes at a fraction of the cost charged by professional builders, and thus helping to solve the problem of the shortage of low-priced rural housing.

My own osier coppice is cut by the Green Wood Trust every January and by September some of the 'wands' are fourteen feet high. In the case of other trees, harvesting intervals vary from three to sixty years. 'Stools' spread as they grow older and some in existence today are fifteen feet in diameter; one ash stool in East Anglia is known to be over 1,000 years old. What are believed to be the oldest living things are certain naturally formed stools of southern beech in Tasmania, the result of trees being constantly blown over in gales. Some are reckoned to be 30,000 years old.

Sustainable supplies of timber can also be obtained by the regular cutting of suckers, or root-shoots, from those trees, particularly elm and aspen, which produce them after felling, and by pollarding, which means cutting larger shoots and branches from tree-trunks some six to fifteen feet above the ground. These ancient systems of sustained woodland management are far wiser, more economical and kinder to the environment than the clear-felling that is commonly practised today.

At an early period our forbears learned to understand and appreciate the distinct properties and appropriate uses of different types of timber: oak, with its great strength and solidity, for the framework of houses and boats; ash, with its toughness combined with elasticity, for tool-handles; sweet chestnut, with its strength and damp-resistance, for fencing and gates; lime, with its soft, 'cheese-like' texture, for ornamental carving; wild cherry and walnut, with their beautiful graining, for fine furniture; hazel, with its coppicing quality, for 'underwood crafts' such as hurdle-making; maple and sycamore, with their relatively non-staining surfaces, for kitchen utensils.

Birch and elder, scornfully dismissed by present-day foresters as 'weed-trees', have in the past been highly regarded for their many uses. In the Scottish Highlands, with their paucity of broad-leaved trees, birch was used for everything, from houses to ploughs, from mill-wheels to ropes. Its thin, supple, springy twigs are still used for besoms and whisks, while its bark has been used as a substitute for parchment and, by North American Indians, for making canoes. As regards the elder, it has been said to have a wider range of uses than any other temperate plant. While its timber has been used for many small objects, from flutes to the cogs of mill-wheels, its every part is believed to have medicinal value. With typical Teutonic thoroughness, a seventeenth-century German physician devoted a 230-page book to the elder alone.

Knowledge of the properties and uses of woodland plants has not been

confined to their potential as timber, fuel, food or medicine. In the absence of factories and chemicals, our ancestors applied their ingenuity, inventiveness and powers of observation to finding ways of satisfying all their physical needs from within the natural world. And, with ever-rising prices and the urge of increasing numbers of people, such as devotees of Permaculture, to adopt ecological, sustainable, non-polluting lifestyles, many ancient practices are being revived. One can gain a profound, atavistic satisfaction, that penetrates to the very core of one's instinctive being, from finding practical uses for the wild plants, with their fascinating forms and fragrancies, which nature – Gaia – provides freely and in such profusion. My living-room is adorned with a herb-rack hanging from the ceiling, and every autumn it is filled with aromatic herbs which are left throughout the winter to dry, and which, in powdered form, can be added to salads and stews or can be laid among garments and bedding as moth-deterrents. These drying herbs give a delicious and healthful atmosphere to the room.

Healing scents are emitted not only by herbs but also by balsam poplars, of which I have a magnificent specimen in the arboretum, and by the resins which are common to all conifers. Resins consist of two main elements: a volatile oil, turpentine, and a solid, rosin. The function of resins is to block wounds in the trees' bark and thus act as an antiseptic dressing against disease germs and fungi. Turpentine, rosin and tar are among products commercially known as 'naval stores', a name which goes back to Elizabethan times when they were used to waterproof wooden ships.

Among many plants much valued by housewives in the past are soapwort, the vegetable detergent, otherwise known as Bouncing Bet, whom Richard Mabey surmises may have been the 'archetypal washerwoman', and horsetail, a living fossil whose ancestry goes back to the Carboniferous epoch 200 million years ago, and which was once used for polishing pots, pans, milk-pails – and suits of armour. This function it was able to perform because the stems and leaves are densely covered with minute crystals of silica. I can testify that it is an effective substitute for a nylon scourer.

The most hated of 'weeds', the stinging-nettle, has long been, for countrypeople in the know, one of the most valued of wild plants. Not only is it one of the most nourishing of foods and potent of medicines, but its fibres can be 'retted' like flax and woven into garments and ropes. When Germany ran short of imported cotton during the First World War, enormous quantities of nettles were collected and used to manufacture military uniforms. Rita Acton possesses a piece of nettle lace.

During the Second World War, Sweden found itself largely isolated from

external sources of supply, but managed to achieve almost complete self-sufficiency, while maintaining a high standard of living, by extremely intelligent and creative application of its forest resources. Factory complexes, powered by wood or wood-products and centred on sawmills, turned out textiles, building materials, synthetic rubber, synthetic leather, paints, varnishes, soaps, adhesives and other essential industrial goods, while a fair proportion of the nation's protein requirements was met by torula yeasts nurtured on wood sugar. While millions of Britons subsisted largely on Spam, one of the standard delicacies of the Swedes' wartime diet was 'hamburgers' made of *Cellulosa-biff*. Motor vehicles of all kinds were adapted to run on wood-generators. From the waste sulphite liquors of the pulp industry, twenty-five million gallons of ethyl alcohol were produced per year, most of which were used as motor fuel. The old art of wood distillation was revived to supply motor lubricants. Tar and pitch distilleries supplied a wide range of industrial and even edible oils. By 1944 Sweden's forests were producing practically everything the country had previously imported, except tea and coffee, and it was the only nation in Europe with higher food rations, warmer houses and more hot baths than in 1941. This wonderful achievement in harnessing and releasing the underexploited resources of the cold northern forests owed much to the vigour, imagination and tenacity of one man: Eric Lundh, Chief Forester of the Royal Fuel Commission.

Another aim of the Greenwood Trust is to lure back the nightingale to Ironbridge Gorge, where it was once common, by creating the kind of coppice habitat that it loves.

In many pre-industrial societies craft-work was and is often accompanied, stimulated and vitalised by work-songs. Each craft has its own set of songs, attuned to its special rhythms and designed to alleviate the strain and tedium of labour. The songs, in fact, supply the equivalent of mechanical energy, with the difference that they uplift the singer, raising his or her consciousness above the mundane plane of work, while machinery is often deafening and depressing. The creation of a work-song may be described as the transmutation of labour and the often painful forces of nature into a constructive entity on a higher plane, so that the toil and stress are transcended and thereby assuaged.

The region of Britain where work-songs were most widely performed was the Outer Hebrides, and the most characteristic and numerous of Hebridean songs were those that accompanied the 'waulking' or fulling of the tweed. A group of women would sit at a long table, passing a length of damp cloth from one to another, while tossing, stretching and thumping it to cause it to shrink. They would perform this arduous task in uni-

son, swinging their bodies to the pulse of an invigorating choral chant. The words were often improvised, bringing in local gossip and sometimes referring to the love-affairs of some of the participating girls.

Kenneth Macleod, the well-known Gaelic poet and scholar who collaborated with Marjory Kennedy-Fraser in arranging many of the Songs of the Hebrides, wrote:

> It is hardly necessary to say that the measure and the time of the labour-songs are suited to the special type of work involved. In the spinning-song, for instance, the long-drawn-out and gradually accelerating phrase culminating in a long pause is evoked by the periodic rhythm of the spinning itself. The wool is carded into rolls or 'rowans'... and the time of the song is determined by the spinner's manipulation of the roll... The wheel and the long chorus go merrily together, gradually getting quicker, till the spinner, prolonging a note, stretches out as far as her right hand can reach what remains of the roll, and then... runs it through the bobbin.

What, then is the place of hand-craftmanship in the modern Western world? Why should men and women subject themselves to the mental and physical strain, the intricate disciplines, of making homely objects by hand, when it is so easy to buy all that one needs – or that one thinks one needs – at the supermarket or hypermarket, the hardware store, the furniture store or the 'fashion shop'? The answer is twofold, and it goes very deep. Firstly, in our industrial society human beings are subjected to intense and continuous external pressures and above all pressures from the mass-media, from advertising. To some people these pressures are almost suffocating and they feel that, at all costs, they must be themselves, they must discover and assert their own identity, they must 'do their own thing'. This deep biological and psychological urge leads to the road of holistic self-development: that is the development of all sides of one's being, physical, mental, emotional and spiritual. This is true freedom, true health, true wholeness, but to achieve it considerable and continuous effort is required. As one explores the different sides of one's nature, so they make their different demands. The soul demands emotional fulfilment, the mind intellectual satisfaction, the spirit higher realms of experience and the hands sensitive creativity. This is the basic reason why people take up crafts; they feel that within their hands are constructive potentialities, which must at all costs be realised, otherwise they will atrophy.

The second factor which leads people to take up crafts is care for the environment. They feel that the manufacture of industrial goods involves

pollution and destructiveness which become ever more intolerable. The answer must be to produce goods that do not involve harmful chemicals and effluents, even if one is obliged to make these goods oneself.

The rewards of creative activity, such as craftmanship, however much anguish it may at times involve, are immeasurable. The objects which one produces are a source of endless satisfaction, which has nothing to do with mere conceit or self-congratulation. They are emanations from one's inmost being, extensions of oneself, almost like new faculties, new states of consciousness, new limbs. And their creation brings a sense of lasting inward security, of serenity. In his book *The English Countryman,* H. J. Massingham cites this quality of serenity as a common characteristic of all the village craftsmen he had known. Writing of the period of the Second World War, he says, 'They are survivors into an alien new world which takes no account of them at all, or, if it does, only as museum pieces.' And he adds: 'To be men of inward peace and balance in such circumstances calls for a toughness of spiritual fibre capable of sustaining no small degree of stress and tribulation. This equanimity of temper, exceeding rare in an age of schizophrenia, is conferred upon them by the nature of their work and their intimate contact with Nature herself. It is not insensibility but poise and, if it owes something to inheritance, still more to lack of frustration, more yet to consciousness of service and even more to the small green world in which they live, it owes most of all to an attunement with the will of Creation itself.' A writer quoted by Massingham in *The Curious Traveller*, says, 'No higher wage, no income, will buy for men that satisfaction which of old – until machinery made drudges of them – streamed into their muscles all day long from close contact with iron, timber, clay, wind and wave, horse-strength. It tingled up in the niceties of touch, sight, scent. The very ears unawares received it.'

In the same book Massingham speaks with warmth and respect of a Cotswold couple who had achieved a full and rounded self-sufficient existence devoted to craftwork combined with organic horticulture. Both were spinners and weavers, while the man was also an expert woodturner. His aim was for the whole craft of textile-making to be the work of a single individual. 'Wholeness can only be accomplished by the worker controlling and literally having a hand in every process of his work, from the raw material to the finished article.'

In this he was of one mind with Gandhi, who founded his system of Basic Education, 'education for living', on practical experience of the making of cotton fabrics, from the sowing of the seed to the completion of a garment. To Gandhi the spinning-wheel was a symbol of self-suffi-

ciency, of freedom from exploitation and oppression. Wilfred Wellock, in *Gandhi as a Social Revolutionary,* writes:

> Basic Education is a process of learning through doing. It recognises the organic connection between the fingers, the senses and the mind, and the greater vitality and retentiveness of knowledge that is gained by doing and making things than by merely reading books or listening to lectures.
>
> In the exercise of all man's powers in purposive, social living, which is essentially co-operative living, Gandhi discovered a unifying principle by which the human person might become a whole person, who must be the foundation of integrated families, integrated communities, and of a peaceful world.

Chapter Eleven

Agroforestry Against World Want

The best answers to Third World problems can generally be found in the Third World itself. Its people have vast reserves of skill, resourcefulness, creativity, inventiveness, energy, survival techniques and will to win, of which most Westerners seem largely unaware. But since many Western aid schemes, notably the 'Green Revolution' and a number of big dams, have proved costly failures, an increasing number of relief workers and agronomists have, from the mid-1970s onwards, been taking a close scientific interest in indigenous methods. When asked to solve the problems of a particular valley, far-sighted administrators have learnt to turn, not to Western mechanical and chemical know-how, but to systems practised in the next valley.

Of course this does not mean that Western expertise in many fields has no role to play in tackling the Third World's colossal and multifarious problems. In the realm of forestry one name must stand out, that of a man of enormous energy and all-encompassing vision, who foreshadowed and inspired the present worldwide Green movement, and even shared Gandhi's convictions linking a post-industrial society with lasting peace. This man was Richard St. Barbe Baker, who, as a young forester in 1922, founded the Men of the Trees in Kenya, a country that is now playing a leading role in many departments of tree-planting and which holds the headquarters of the International Council for Research in Agroforestry.

In his book *My Life My Trees* St. Barbe describes the devastation of the forests in the Kenya highlands caused by nomadic herdsmen, land-hungry white farmers and logging contractors. The young forester's response was to demarcate a wide area and get it gazetted as a forest reserve. With the co-operation of a man who was to be his lifelong friend and colleague, the Kikuyu chief Josiah Njonjo, St. Barbe had thousands of indigenous trees planted between rows of corn and yams – an agroforestry system. At the same time he started Kenya's first large tree nursery, planting olives in conjunction with Mutarakwa cedars, an association found in the natural

forest. Thus, from the first, as he admitted, St. Barbe took advantage of the local tradition of mixed cropping.

Later St. Barbe became responsible for the sustainable development of mahogany rainforests in Nigeria, where he observed another example of plant symbiosis.

> Each mahogany is surrounded by numerous trees belonging to other families, amongst which is that important family of Leguminosae – the soil improvers. These I have observed to be good nurse trees for the mahoganies. The more important species of mahogany require the services of a succession of nurse trees throughout their life to bring them to perfection. Some of these provide just sufficient competition to coax the young sapling upwards. Others do their work in secret under the surface of the soil, interlacing the roots, a sort of symbiosis, like the mycelium, which starts as an independent web-like growth, surrounds the sheath of plant rootlets and prepares food that can be assimilated by the growing trees.

In the 1950s and 1960s St. Barbe undertook two extensive expeditions through and round the Sahara, and put forward a breath-taking plan for the reclamation of the world's largest desert by progressive tree-planting.

In their foreword to his book *Sahara Conquest* John Hutchings and Knut H. Scharnhorst write:

> This outstanding book introduces us – in a bold yet down to earth manner – to a new way of thinking. Against the sombre background of a world-wide population explosion with its serious food problems the author calls for immediate, concerted efforts to restore to the world in general and to the Sahara in particular, the potential productiveness of abused and abandoned land. Man must stop defying the laws governing him in his relations to Nature, especially the basic law of balances. Instead, the nations must adopt and adapt the principles of ecology in dealing with human problems. This goes – in the author's opinion – not only for re-afforestation but, logically, also for reduction of animal husbandry to adequate proportions. Never has ecology had a more objective and articulate spokesman than in Richard St. Barbe Baker, who also more than any other Westerner loves Africa and her people.
>
> Co-operation on a large, international scale, such as Mr. Baker invites in the case of the Sahara, would go far to change the political climate of the nations. Just as Mr. Baker's reclamation plan envisages the creation

> of micro-climates in the Sahara, that will eventually coalesce into a beneficial climate over the whole area, so will the total African venture in itself act like a micro-climate, which will gradually expand to the whole of our fractious and contending planet.
>
> What is here presented is not just an abstract scheme proposed by a poet dreamer (though the author is indeed a poet). It is the plan of a practical forester, who has spent his life in the pursuit and study of his subject from every technical point of view, who has travelled the world over and who has seen for himself the cancerous condition in which the surface of our planet finds itself...
>
> Mr. Baker is an acknowledged world authority, who can point to huge areas reclaimed or saved by his inspiration and who here assures us that with up to date knowledge and modern techniques a million square miles of the Sahara can now be reclaimed. In a sorely perplexed world, this book is a sweeping Charter of Sanity that points the way to sound prosperity, wellbeing and peace, not only for the Uniting States of the Sahara, but for all of us.

In fact St. Barbe did not put forward a detailed programme but encouraged the Saharan states which he visited to proceed with schemes best suited to their individual talents, policies and resources. He was particularly impressed by large-scale desert colonisation schemes being pioneered by Egypt, one of which involved 5-acre family orange groves with leguminous crops such as peanuts and cowpeas growing beneath the trees.

While water for some of the projects was provided by irrigation channels from the Nile, in other cases wells were sunk, some of depths as great as 3,600 feet. Ancient wells, some going back to Roman and pre-Roman times, were discovered and opened up. There is said to be an underground sea the size of France beneath the Sahara. This could doubtless be made available for irrigation by modern oil-drilling techniques.

The remains of ancient civilisations have been found near the centre of the Sahara. Their water-supplies must have been assured by the presence of forests, but when these were cut down and regeneration made impossible by browsing animals, the water-table, maintained by the trees' roots, would have sunk to great depths.

St. Barbe's vision of a Green Belt round the Sahara was revived at an exhibition in London in October 1989, sponsored by a number of relief agencies. The exhibition did not envisage an endeavour to plant a contin-

uous shelterbelt round the desert's entire perimeter, but a mosaic of protective zones, comprising forests of drought-resistant trees and crops, which would eventually merge.

Innumerable forms of land-use practised in Africa, Asia and Latin America, whether traditional or extemporised, have agroforestry characteristics. It is being increasingly recognised that symbiotic systems, involving the integration of trees with other crop-plants, constitute a vast and complex subject of study, which contains the seeds of a comprehensive new-old technology for meeting all basic human physical needs.

Paul Harrison in *The Greening of Africa* praises 'the resourcefulness and energy of Africa's farmers' and adds:

> There is here a tremendous untapped potential for rapid innovation... Africa's peasants, in my experience, are among the most inventive and adaptable in the world. They have to be, because they are dealing with the most varied and unpredictable environment in the world. They are always open to new varieties, even new crops, that can make the best of their limited resources... British anthropologist Paul Richards has shown that traditional farmers, untouched by conventional development projects, select and breed their own improved varieties, carefully adapted to the needs of their location... In no other continent is there such a diversity of farming methods... They have developed dozens of ways of moulding the soil, planting sometimes in ridges and mounds in wet areas to improve drainage, sometimes in furrows and hollows in dry areas, to collect scarce water.
>
> Patterns of intercropping are even more diverse. In northern Nigeria as many as 156 separate crop combinations have been observed.

In south-eastern Nigeria, to meet the challenge of one of Africa's most densely-populated areas, a sophisticated system of forest gardening has been developed. 'Compound farms', some very small, are established in the immediate vicinity of homesteads. A very wide diversity of trees, bushes and other crop plants are grown, designed to meet all the basic needs of the farmers and their families: fruits; vegetables (including perennial tree vegetables); timber for building, staking and fencing; fuel; fertilisers; leaf wrappers; medicines; fibres for ropes, stuffing mattresses and thatching; calabashes for containers; charcoal; wood for tool handles; snake repellents; gums; dyes; kitchen utensils; spices and water purifiers. Many of the trees are used for multiple purposes. So sophisticated and complex is the 'architecture' of some of the gardens that as many as nine

Fig. 22 Chagga forest garden (illustration © IIED)

storeys have been counted: from high emergent coconut and oil palms to medium-sized trees such as breadfruit and pear and lower trees such as mango, orange and lime. On a still lower level grow papaya and bananas, with pepper bushes occupying the shrub layer. Maize and vegetables constitute the herbaceous layer, while melons, peanuts and other horizontally spreading plants cover the ground, and root vegetables occupy the rhizosphere. The vertical dimension is formed by yam vines trained up trees. The genetic diversity of the plants makes the gardens important as germplasm banks, supplying replacements for genes lost as a result of forest destruction. The system, which is believed to have originated 1,000 years ago, and so has been tried and tested over the centuries, could serve as a model for many other parts of Africa – and the world. People who have evolved and are prepared to maintain such a complicated system must be determined to survive at all costs!

Another forest garden system with more commercial implications has been developed by the Chagga people of Tanzania amid glorious scenery

on the slopes of Mount Kilimanjaro. The special sophistication of this system lies in the network of skilfully aligned irrigation channels designed to make full use of the melting snows. The network, which is very complicated, is managed co-operatively by all the smallholders and is so arranged that each one gets his fair share.

The Chaggas were originally members of a number of different tribes who, over a century ago, moved into the dense montane rain forest on the lower slopes of the great mountain, which covers an area of more than 3,000 square kilometres, and rises to 5,895 metres above sea level. When the first missionaries reported seeing a snow-capped mountain just south of the Equator, their superiors refused to believe them. The pioneer Chagga settlers refrained from felling the larger and more valuable trees in the forest, but planted bananas and other fruit and vegetables in their shade. Now the individual plots, which average 0.68 hectares in size, each one maintaining a family of about ten people, generally have a seven-storey structure. At the top are the tall timber trees, including teak, of the natural forest. In their shade grow shorter trees, providing fuel and fodder. Lower still is the fruit storey, mainly comprising bananas but including other fruit and fodder trees as well. Next comes the coffee layer, which also includes some medicinal plants. The herbaceous layer comprises vegetables such as beans, cabbages, cowpeas, onions and tomatoes, as well as maize, and also young saplings of natural species which have been allowed to survive. The rhizosphere is occupied by potatoes, taro and other root crops, while a vertical dimension is created by yams which are trained up trees.

Over a hundred different species are grown, supplying most of the families' personal needs throughout the year, as well as bananas and coffee which are sold. The Chagga area contributes more than fifty per cent of Tanzania's coffee output and therefore makes an important contribution to the country's GNP. The most valuable products are the choice timber trees.

An intensely interesting feature of the system, which deserves scientific research, is that a number of plants are grown for their symbiotic qualities, in repelling nematodes and other pests. Chemicals are seldom used.

Great expertise is shown in managing the system, as the smallholders have an intimate knowledge of all the plants and their ecological requirements. For example, when the time is ripe, the canopy is opened out to facilitate the fruiting of the coffee bushes, while each banana clump is pruned to ensure that it has three to five pseudostems of different ages, thus making for continuous harvesting. Young timber trees are grown in close proximity to other plants to encourage straight stems with few

Fig. 23 Profile of tropical rainforest showing storeys (illustration ©IIED)

branches. The wide diversity of very carefully chosen plants is an insurance against both epidemics and crop failures. If one crop fails, another is likely to be a resounding success.

Tenure of each forest garden, or *vihamba*, is hereditary, and is based on a very strong conviction that a close link exists between a person's ancestors and the soil. Traditionally the land was divided only between the deceased owner's sons but now the daughters are included. Each family, also has another plot, called a *kishamba*, held by annual tenancy, in the plains. These plots are mainly used for annual crops, though a few trees are grown in them, mainly for fuel.

This combination of upland and lowland husbandry reminds me of a system which I found operating in the Val d'Anniviers in Switzerland. There, dairy farming was the main occupation in the mountains while each family also had a share in a vineyard in the Rhone Valley. At the beginning of spring all the men marched down to the valley to work in the vineyards, carrying their hoes and headed by a fife band, leaving the women to look after the cattle.

Another very interesting forest garden system in a mountainous rainforest area is that of Maninjau, an extinct volcano on the island of Suma-

Fig. 24 Mangrove tree

tra. The setting is dramatic in the extreme: steep mountainsides clothed with remnants of primaeval forest sloping down to a volcanic lake, subject to dangerous landslides and violent storms.

Just as the inhabitants of Saxon England left patches of virgin forest undisturbed close to their villages, to supply them with timber, herbs and other necessities, so the inhabitants of Maninjau build their villages round tongues of natural rainforest. Above the 900-metre line is a large State-run forest reserve, from which the villagers are forbidden to collect wood and rattans (creepers). In the buffer-zone between the forest and villages are the majority of the forest gardens, though smaller homegardens surround many of the houses. In these the villagers plant their most valued fruit trees, for security reasons. The villagers also cultivate rice in permanent irrigated fields at the bottom of the slopes and by the lakeside. The land in general is owned communally by the clan.

The forest gardens are densely planted with a wide diversity of trees and other deep-rooting perennials, to guard against landslides and erosion. Annual vegetables and maize are grown beneath the trees and also in the ricefields, between harvests. All the gardens are dominated by six specially favoured trees and bushes: durian, cinnamon, nutmeg, coffee, *Pterospermum javanicum*, a large timber tree commonly grown in asso-

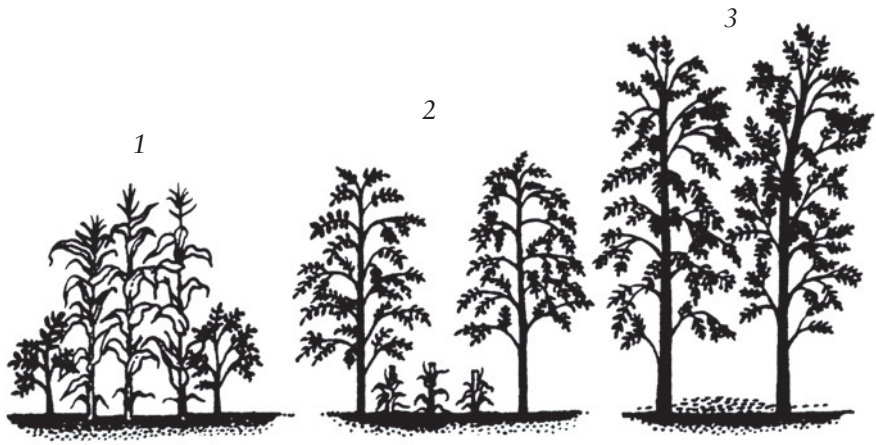
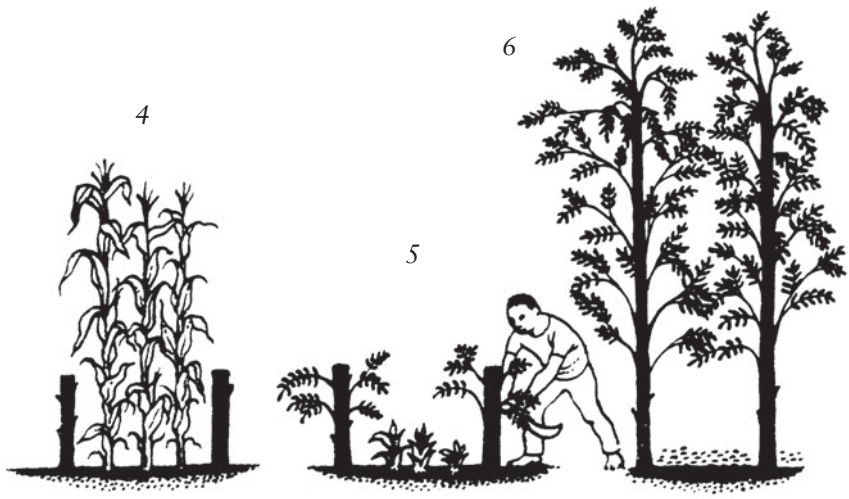


Fig. 25 Alley-cropping with leguminous trees like Leucaena. *In the first year the seedlings are planted with the crops (1,2), then allowed to shoot up in the dry season (3).*



In subsequent years, the trees are pruned for wood, fodder and mulch while crops are growing (4,5), and allowed their head again in the dry season (6).

ciation with durian, and *Toona sinensis*, a medium-sized timber tree regarded as particularly suitable as a shade-tree for nutmeg and coffee. At the head of all these trees in local preference must come the durian, whose large, spiny fruits are loved by millions of people in Southeast Asia but detested by others for their sewage-like smell. Appropriately enough, durian rinds are used for manuring coffee bushes, which, together with

nutmeg trees, are often grown beneath the shade of the durian trees. Among other fruit grown or collected from the wild are bananas, papayas, guavas, mulberries, mangoes and mangosteens. Many bamboos are grown both for their edible shoots and for construction purposes. The peasants have an intimate knowledge of their plants' ecological and cultural requirements. Almost all the work is done by family labour; very little machinery and no chemical fertilisers are used. The whole system is highly stable and sustainable, and yet readily adaptable to changing needs and economic conditions. To counter the unreliability and fluctuations of market demands for the cash crops – coffee, cinnamon and nutmeg – the peasants maintain a solid nucleus of subsistence crops, so they are never obliged to go short of necessities.

As in the case of other forest garden systems, the wide diversity of home-bred and semi-wild species provides a gene bank which is potentially of great value for plant-breeders in other parts of the world, who find many sources of supply dried up by the destruction of the natural forests.

That the rainforest peoples should be allowed to survive and develop in their own indigenous ways, aided and supported by legitimate, constructive forms of Western technology, mostly in its 'intermediate' or 'alternative' forms, is of importance to us all. One American psychologist, Jean Liedloff, has even created a system of psychology and child care which she calls *The Continuum Concept*, based on several years' intimate contact with the Ye'cuana, a tribe of Amazonian Indians. Briefly, the Continuum Concept describes the security derived from the extension of maternal protectiveness and stimulus, which has been the main biological means responsible for the evolution of the higher animals and human beings, into the sphere of communal living. The autonomous village community, which is the highest unit of Ye'cuana society, is the solid, supportive matrix within which almost all activity takes place. In an emergency, any member of the community can rely on the wholehearted aid and support of the rest. Social responsibility rather than competitiveness characterises the whole of Ye'cuana life, and, as everyone, from earliest childhood, is expected to act altruistically without compulsion, unbroken harmony is the general rule.

The forest community is so deeply embedded in its environment that it conforms to the laws of its ecosystem as implicitly as do the animals and plants. Peter Bunyard in *The Colombian Amazon* writes:

> The dynamic of the forest and the interchange of matter between one species and another, including that of life-force, provides the Indians

> with a ready model of their own existence within the community of the *maloca* (communal house). Hence the local economy both within the community and with neighbouring communities relies heavily on the principle of exchange and reciprocity both within themselves as human beings and with nature... Gerardo Reichel-Dolmatoff has good evidence that the rituals and beliefs of the Indians of the eastern part of the Colombian Amazon are based solidly on their conscious experience of how the ecosystem works and is an attempt to reflect that natural functioning within their own cosmologies.

A dominant feature of all true, unspoilt forest people is a respect for the environment, amounting sometimes to religious reverence, based on intimate, inherited understanding of its flora and fauna, its processes and rhythms. The Yanomani of the Amazon rainforest, the largest unacculturated tribe in the Americas, have an amazingly varied diet and pharmacopoeia derived from both wild and cultivated sources. While they collect more than 500 different wild plants, including many fruits, they also clear small areas in the forest, called *chagras*, in which they create temporary but highly diversified forest gardens. These, after a short time, they allow to become overgrown, in order to restore the fertility of the thin rainforest soils, while they move on to clear other patches. The forest gardens thus become constituents of the forest ecosystem, which is thereby enriched, becoming even more productive of economically valuable plants.

The Ye'cuana village community apportions its cultivating and foraging area into a number of distinct zones. Immediately round the village or *maloca* lies the forest garden, in which they plant their favourite fruit-trees, such as peach palm, papaya, pear, mango, lemon and *maraca*, a kind of cacao. Next comes the nearby forest, from which the people reckon to collect some 170 different species of wild plant, not only for food but also for timber, fuel, medicines, utensils and dyes. In this and the more distant forested areas are found sites destined for *chagras* as well as *rastrojos*, which are abandoned forest gardens in various stages of regeneration, which are still visited for their surviving fruit-trees. There are also various wetland areas, including *cananguchales*, permanently or seasonally flooded, which contain a tree called *canangucho*, which is much prized for its fruit.

The Baka of the Central African rainforest divide their lives into settled periods, when they do some cultivation, and a nomadic phase which begins with the onset of the rainy season and the fruiting of the wild mango tree. Their camps comprise small igloo-shaped huts woven by the

women from wild saplings and thatched with large leaves.

One of the supreme benefits that the human race could gain from the rainforest, which in many countries is being so ruthlessly destroyed, is an immense expansion and diversification of its diet. At present the vast majority of the world's population suffer from inadequate nutrition. There is the malnutrition of poverty and the malnutrition of affluence. While hundreds of millions of people eat too little, tens of millions eat too much of the wrong foods. Comparatively few people consume sufficient quantities of the two basic essentials for all-round, lasting, positive health: raw green leaves and fresh fruit. Moreover, if one is to be sure of obtaining all the desirable vitamins, enzymes, minerals and other nutrients, a widely varied diet is needed. For this reason, a far-ranging programme of nutritional research should be undertaken into the foods consumed by the Yanomani and other forest people who are experts on the environment. At the same time there are numerous neglected food plants in the comparatively species-poor temperate regions. Also we should not forget that every *variety* of common fruits such as the apple, plum, pear, raspberry and gooseberry has a different biochemical constitution, and therefore contains different trace-elements. As a very limited number of varieties are obtainable in the shops, and most of these have been sprayed and grown with chemical fertilisers, everyone with a garden of any size should endeavour to grow a few of the non-commercial varieties, which are generally superior in flavour to shop fruit. This is why I grow a wide diversity of fruit and nut trees, including uncommon ones, such as *sorbus* species and the azerole, an edible hawthorn.

Forest gardening, in the sense of finding uses for and attempting to control the growth of wild plants, is undoubtedly the oldest form of land-use in the world. One of the newest is alley-cropping, a form of agroforestry developed during the 1970s and 1980s by B. T. Kang, an Indonesian soil scientist, and his colleagues at the International Institute of Tropical Agriculture, Ibadan, Nigeria. It was an attempt to find answers to two problems: soil erosion on sloping ground and the acidification and impoverishment of the soil, which are the long-range results of using chemical fertilisers. The system which Kang and his colleagues came up with involved the growing of cereals and vegetable crops in narrow strips between hedgerows of leguminous trees. The trees, with their deep roots, prevent erosion, and with their nitrogen-fixing ability fertilise the crops. They are regularly and heavily pruned to prevent them from shading the crops, the prunings being used as mulch to suppress weeds, as stakes or firewood, or as fodder to be fed to livestock. Hedgerows along the contours of sloping ground accumulate loose soil and in time a series of terraces develops.

The trees must be fast-growing, and among those that have proved most satisfactory are *Leucaena leucocephala*, a native of southern Mexico, otherwise known as ipil-ipil or subabul, *Calliandra calothyrsus*, a small Central American tree with showy flowers resembling crimson powderpuffs, and *Sesbania Grandiflora*, a very valuable multi-purpose tree from Asia with large white or wine-red flowers that have been described as 'vegetable humming-birds'! Philistine though it may seem, these flowers, which are rich in sugar, are sold in many Asian markets for food – they are said to taste like mushrooms. Sesbania pods are eaten like runner-beans and the seeds, among the richest in protein of all legumes, are dried and eaten like soya beans. The leaves, which are also rich in protein as well as vitamins and minerals, are eaten as spinach. In traditional agroforestry the tree is used as a support for pepper and vanilla vines.

Bill Mollison told me that Sesbania roots are so powerful that he has seen the tree used for reclaiming rock-hard lateritic soils. Leucaena, another tree with an aggressive taproot that can shatter rocks and which is also amazingly fast-growing, has, in numerous field trials, proved the most satisfactory hedgerow tree for alley-cropping. Crop-yields are not reduced but increased in its neighbourhood. It was a favourite tree of the Maya and Zapotec civilisations of Mexico and Central American, in whose area traditional forest gardens, which doubtless owe their origin to those civilisations, are still found.

Following the successful Nigerian field trials, alley-cropping has spread to other parts of Africa, Indonesia, the Philippines, India and Sri Lanka.

Leguminous plants should be an essential constituent of all agroforestry/permaculture schemes in every habitable part of the world, because of their value as companion plants, giving fertility to their neighbours. The fruits and seeds of many leguminous plants are sources of the first-class protein in which many Third World diets are deficient. It is true that some pulses contain toxins, but reliable methods have been developed over the centuries of detoxifying them. These include boiling them and throwing away the water, and also various forms of fermentation practised in the Far East which have resulted in products, well known in Western health-food stores, such as tofu, tamari, soya milk and soya cheese. In fact, soya beans have been among the main sources of protein for thousands of years in China, Japan and Korea, areas where livestock farming is far less widespread than in the West.

As many leguminous plants are fast-growing, they can provide a regular source of fuel and biomass-energy. One of the most heartrending human tragedies in many parts of the arid tropics is the long and gruelling journeys that millions of women have to take, week in week out, to fetch

firewood from ever-receding and dwindling patches of woodland. In parts of the Himalayas women have been known to fall to their death out of sheer exhaustion. But leguminous trees exist that can flourish in the most arid and even heavily salinated soils, as well as in rock-crevices on mountainsides with no visible soil. So there is no reason why leguminous trees should not be grown in abundance in all deprived areas, to provide fuel for cooking, lighting and heating, thus releasing women from the chore of firewood-gathering and enabling them to use their talents and energies in more creative ways: bringing up their children and practising the crafts in which many of them excel.

In order fully to understand agroforestry/permaculture at its best, as illustrated by the tropical forest garden systems I have described, it is essential to appreciate that it involves skilled craftsmanship – and more. The task of creating balanced relationships, rhythms and patterns of growth demands intuitive, aesthetic qualities, comparable to those that lie behind the exquisite artefacts – textiles, pottery, metalwork, carvings – produced in many countries of the Third World.

A tropical rainforest is a supreme and infinitely varied work of art, but, with a touch of human genius, it can be converted into a forest garden system, even more beautiful and vastly more productive. That is why it is not enough merely to campaign for the preservation of the rainforest. It is a compound resource of potentially enormous value to humankind as a whole, if developed – not devastated – in a wise, constructive, sustainable way. Its vast diversity of vegetation, up to now so inadequately studied by science, could be used as a source of new and nourishing foods, of timber for building and crafts, of fibres and dyes for textiles, of medicines, of biomass for energy, of gums, resins and plastics, to meet almost all human needs, above all the basic soul-need of beauty.

Wagner in his operas strove to achieve a *Gesamtkunstwerk*, a total work of art. A forest garden, replete with fruit and foliage, blooms, birds and insects, mammals and fungi, fascinating scents and sounds, can be a work of art comparable to any of humankind's highest cultural attainments.

The new but also age-old technology involved constitutes a safe, sustainable, non-polluting and above all profoundly practical answer to the technology developed since the Industrial Revolution which, despite the many benefits conferred, is now inflicting ever greater and more unacceptable damage on the environment. The new technology has very deep roots in the hereditary manual skills, which, above all in the Far East, have enabled workers to adapt to the stringent demands of the most advanced and intricate forms of 'hi-tech'. This new technology must be

developed so that it can help to lead humankind into a safer, kinder, calmer and more peaceful post-industrial age.

Chapter Twelve

Green is Real

In *The Great U-Turn* Edward Goldsmith describes how the Industrial Revolution has transformed the 'real' world of forests, fields, orchards, gardens, rocks, rivers and lakes, which, until the last two centuries, satisfied almost all human physical needs and enabled human beings to attain the highest peaks of cultural achievement, into a 'surrogate' or artificial world of cities, factories, motorways and airports. He then goes on to suggest various steps by which this 'surrogate' world could be 'de-industrialised'.

In putting forward a skeleton programme of action, he emphasises that 'it must be designed to reverse all the essential trends set in motion by the industrial process'. The first stage, he maintains, must be to develop a new world-view to replace the 'aberrant world view of industrialism', in order to see how its basic principles may be 'modified to give rise to an adaptive and hence stable social behaviour pattern'. After enumerating and refuting these principles as humanism, individualism, materialism, scientism, technologism, institutionalism and economism, Goldsmith concludes: 'For economism must be substituted ecologism, the notion that things must be done to satisfy not a single end but all the basic, and often competing requirements of the community and its natural environment.'

Goldsmith's second stage is a shift from 'capital intensive industry' to developing the 'appropriate' technology for decentralized living. His third is 'the transformation of society' so that it would once more be composed of people who are, above all, members of families, communities and ecosystems, and whose behaviour is basically that required to satisfy the requirements of these systems and hence of 'the larger system of which they are a part, the biosphere'. His fourth is to 'reverse the system of capital generation by means of the production-consumption process', until the need for capital is reduced. The fifth and sixth stages of his de-industrialising process are: 'reducing the scale of the production process and producing goods that are ever less destructive to the natural environment' and 'reducing the scale of technological activities to permit the restoration of the self-regulating social systems which make up the real world'.

Goldsmith also proposes the formation of a Restoration Corps, recruited from the ranks of the unemployed, to 'clean up the mess left by a century and a half of industrialization – restore derelict land, replant hedgerows, restore forests, clean up tips where poisonous waste threatens ground water reserves'.

Some of these aims would be fulfilled by the implementation of a Community Forest programme that has been put forward by Britain's Countryside Commission and Forestry Commission. In July 1989 these two national bodies launched a programme to establish twelve new forests on the fringes of large urban areas in England and Wales. Also an extensive new forest is to be planted in the Midlands and another between Edinburgh and Glasgow. By the turn of the century it is hoped that every major city and town in Britain will have its own community forest. Many areas of industrial dereliction and abandoned farmland will be restored to something of their pristine beauty, with innumerable trees, flower-filled glades, lakes, clear streams and abundant wild life. While some commercial forestry will be undertaken, lessening Britain's present overwhelming dependence on imported timber, and some farming and market-gardening will continue, the main aim of the new forests will be to provide leisure and recreation facilities for towndwellers, such as open-air concerts, plays, art exhibitions and sporting events.

Any initiative that involves large-scale tree planting must be warmly welcomed, but to what extent will the new community forests further the aims of a Green Society? In their prime role as 'amenity areas', the forests will be regarded as marginal to the 'real' world of industry, commerce and finance. But in the opinion of Edward Goldsmith and the vast majority of members of the Green-Alternative movement, that is not the real but the 'surrogate' world. The real world is Green. But how real is real, and how Green must we be in order to be realistic?

To my mind, the basic criterion must be *responsibility*. The Green world is the responsible world. It recognises that the basis of all life is the miracle of the green leaf. The green pigment, chlorophyll, is the only substance on earth that understands how to harness the energy of the sun to create living matter. Moreover the green leaf absorbs harmful carbon dioxide, the cause of the greenhouse effect, and exhales oxygen, without which no living organism can exist for more than a few minutes. Therefore our first duty to all life is to preserve as much greenness as possible and to promote an ever-increasing abundance of green growth. Industrial society, on the other hand, is essentially hostile to greenery. It kills it with its acid rain, it buries it beneath layers of concrete, it burns and bulldozes it out of existence. Therefore measures to ameliorate the colossal harm

that it does are not enough. For the sake of all life, we must at all costs progress as speedily as possible towards a post-industrial society, which will meet the majority of its physical needs from the infinite and largely unexplored potentialities of the green world.

In the Third World two prophet-pioneers, little known in the West, have, for many years, been waging a series of truly heroic struggles to build Green, just and compassionate societies, dedicated to the development of whole human beings. They are Murlidhar Devidas Amte, known to millions of Indians as 'Baba' – Father – and Ahangamage Tudor Ariyaratne, known to millions of Sri Lankans as 'Ari'. Both are disciples of Mahatma Gandhi, which means that they are totally and constructively non-violent in their methods, though both have frequently been obliged to confront conflict situations. Amte's greatest achievement so far has been Anandwan, a large and mainly self-supporting community in Central India, comprising sufferers from leprosy and other severe handicaps, most of whom have attained a surprising degree of self-fulfilment by acquiring manual and intellectual skills.

Anandwan started in a forest and is now restoring its tree-cover in the form of a large and thriving agroforestry research project and what must be the largest forest garden in the world – comprising 25,000 trees!

The foundations of Anandwan were laid in 1950 when Amte applied to his state government for a grant of land to start a leprosy rehabilitation centre, and was allocated fifty acres of stony jungle infested with tigers, wild boars, poisonous snakes and giant scorpions. With a mixture of indomitable courage and cynical humour he named it Anandwan – Garden of Bliss! With his young wife Sadhana, two baby sons, six leprosy victims and a lame cow, he set to work to convert this forbidding area into a model farm. And, astonishingly, within two years he succeeded. The little colony was self-sufficient in food except for sugar, salt and oil. Crop yields were three times the local average. From then on progress was rapid. The state government gave Amte another 200 acres, patients flocked in and helped to build workshops, homes, a dairy and a flour-mill. In 1964 patients and cured leprosy sufferers demonstrated the effectiveness of their acquired skills by building a college for 1,400 students from the local town.

Over the years Anandwan has thrown out a number of offshoots, all in difficult areas and all demanding the highest human qualities from the handicapped people who participated in their reclamation. Most difficult of all was a remote expanse of rainforest inhabited by a 'Stone Age' aboriginal tribe, the Madia-Gonds. It is a country of wide, crocodile-infested rivers, cut off from the rest of India for seven months in the year by flood-

ing. Amte had first visited the area on a lone trek at the age of fourteen, when he had fallen in love with its high-spirited, fun-loving, generous, honest people. Forty-five years later he returned with his elder son Vikas, a trained doctor, and was appalled to find how their condition had deteriorated. Following contacts with 'civilisation', malnutrition, malaria, tuberculosis and leprosy were rife. Baba and Vikas established a small clinic and travelled round the area, treating the sick. The following year their work was taken over by Amte's younger son Prakash, a surgeon who shares his father's adventurous and dedicated spirit, as does his wife Mandakini, an anaesthetist. After twelve years, with the aid of volunteers, the young couple have set up a hospital, several health centres, a scheme for training aborigines as 'barefoot doctors' on the Chinese model – and a zoo for orphan animals!

But in the early 1980s a new threat to the tribal people's very existence appeared in the form of proposals to build a series of giant dams, which would submerge large areas of the forest, which is their main life-support system. Mainly involved is the Narmada, one of India's sacred rivers. After campaigning, so far in vain, to halt the proposals, Amte decided to devote himself entirely to putting forward constructive counter-proposals to develop the area primarily in the interests of the local inhabitants. In a booklet entitled *Cry the Beloved Narmada*, he outlined a strategy for replacing the proposed irrigation and power-generating schemes by alternative systems more beneficial to the environment, the people and India as a whole. Among his suggestions are: agroforestry; improved dry farming methods, including strip-cropping and intercropping; erosion-control measures; water-harvesting techniques, and numerous small hydro-electric stations.

Having left his beloved Anandwan to dedicate himself wholly to this new venture, the running of the community remains in the capable hands of Sadhana and Vikas, who are developing a number of schemes, especially involving alternative energy and agroforestry, which they hope will make the whole vast enterprise into a model for the new India. In 1990 Vikas travelled to London to accept, on his father's behalf, a prize for religious achievement. In his address of thanks, Baba wrote:

> At Anandwan we, outcasts living with outcasts, have built a world which embraces all who wish to come and join. A world where you do not stand alone, where you belong to others who belong to you... Where those rejected by an unconcerned and uncomprehending world realise their own worth with their own hands... These rivers, these forests, these forms of life – we have not inherited them from our forefathers,

> we have borrowed them from our children yet to be born. Their preservation, their enrichment is the solemn responsibility we bear.
>
> Today I have become part of the battle to save the Narmada... there is a plan to build thirty massive dams on the river, which will destroy an entire civilization that has grown in the Narmada valley... The battle is not to save the Narmada alone. The larger goal is to bring the message of Mother Earth to the whole world. To stop the process of destructive development and to ring in this new vision – of a new way of being in the world.

A similar all-embracing vision inspires Dr Ariyaratne (Ari) of Sri Lanka, founder of Sarvodaya Shramadana, which must be the biggest community development movement in the world, involving six million people in 8,000 villages. Sarvodaya is a Sanskrit word meaning Welfare of All which was coined by Gandhi to define his politico-economic system after reading Ruskin's *Unto This Last*. Shramadana is a Singhalese word which means Sharing of Human Energy. The movement was started eight years after Amte laid the foundations of Anandwan, when Ari, then a science teacher at a leading Colombo college, famous for its cricket teams, organised a fortnight's 'work-camp' for a group of his senior pupils outside a remote village of destitute, outcast people.

In Ari's own words, he wanted his students to 'understand and experience the true state of affairs that prevailed in the rural and poor urban areas..., to develop a love for their people and utilize the education they received, to find ways of building a more just and happier life for them'. Instead of imposing their ideas on the villagers, the students asked them what were their principal needs, while experiencing their living conditions by sharing their homes, food and work. They had long discussions at village 'family gatherings'. The 'work-camp' concept caught on and soon similar camps were organised in many parts of the island. In these well balanced teams of health, agricultural and educational specialists worked side by side with unskilled labourers to restore the villages' traditional self-sustaining lifestyle, while introducing modern 'alternative technology' mechanisms where these were appropriate. Once the development work had been set in motion, it was largely placed under the control of the villagers themselves, some of whom were trained as cadres to maintain the momentum of reconstruction.

Ari, in an article in *Ceres*, the organ of the United Nations Food and Agriculture Organisation, wrote:

> Shramadana camps are the places where the young and old, the educated and illiterate, the privileged and the forgotten, all meet and serve one another as equals. The Shramadana volunteers... identify themselves with the traditional culture of the community and... do not impose their will on the people nor adopt a patronising attitude towards them... In the camp each person according to his or her capacity shares energy and skills with others... The camp with its songs and dances, work and study, truly becomes the ideal human family in microcosm where self-fulfilment and joy of living become a reality... This type of experience, sometimes knee-deep in mud, brings about a new awareness.

Awareness – awakening – this, in Ari's view, is the indispensable psychological foundation of the Shramadana process. Joanna Macy, in *Dharma and Development*, writes:

> The Sarvodaya Movement sees any development program as unrealistic which does not recognize and alleviate the psychological impotence gripping the rural poor. Sarvodaya believes that by tapping their innermost beliefs and values, one can awaken people to their *swashakti* (personal power) and *janashakti* (collective or people's power).
>
> It sees this awakening as taking place not in monastic solitude, but in social, economic and political interaction... Sarvodaya's goal and process of awakening pulls one headlong into the 'real' world.

Basic to the Shramadana process is the identification of *real* human needs – common to all – as opposed to the factitious 'needs' inculcated in Western society by the power of advertising. These, in Ari's words, are:

1. A clean and beautiful environment
2. A clean and adequate supply of water
3. Minimum clothing requirements
4. A balanced diet
5. A simple house to live in
6. Basic health care
7. Simple communication facilities
8. Minimum energy requirements
9. Total education
10. Cultural and spiritual needs

In Australia, one of the leading philosopher-pioneers of the alternative

movement is Ted Trainer, an educationist at the University of New South Wales. While writing in cogent terms about the dangers and potentialities of this most critical period in world history, he is building his personal development model in the form of a 'Mini-Machynlleth' (referring to the Centre for Alternative Technology in Wales) at a place with the delightful name of Pigface Point.

In a paper entitled *The Conserver Society*, Trainer writes:

> It must be a *far less affluent* way of life. We must aim at just producing and consuming as much as we need for comfortable and convenient living standards. We must cut right back on unnecessary consumption and we must recycle, design things to last and to be repaired. We must phase out entire industries, such as sports cars.
>
> This is not primarily a matter of reducing unnecessary personal consumption, although that is important. The main changes that are needed here are in our social system and procedures. For example our food producing system involves much transport, meaning that we must change to having much more food produced where people live, which in turn means we must redesign suburbs and cities to have market gardens within them.
>
> We must develop as much self-sufficiency as we reasonably can at the national level (meaning less trade), at the household level, and especially at the neighbourhood or local regional level. We need to convert our presently barren suburbs into thriving regional economies which produce most of what they need from local resources.
>
> Market gardens could be located throughout suburbs and even cities, e.g. on derelict factory sites and beside railway lines. This would reduce the cost of food by seventy per cent, especially by cutting its transport costs. More importantly, having food produced close to where people live would enable nutrients to be recycled back to the soil through garbage gas units. Two of the most unsustainable aspects of our present agriculture are its heavy dependence on energy inputs and the fact that it takes nutrients from the soil and throws them all away.
>
> We should convert one house on each block to become a neighbourhood workshop, recycling store, meeting place, barter exchange and library. We could dig up many roads, thereby increasing land area by one-third or more because we will not need the car very much when we reduce

> production and decentralise what's left. When we have dug up those roads we will have much communal property so we can plant community orchards and forests. Most of your neighbourhood could become a Permaculture jungle, an 'edible landscape' crammed with long-lived, largely self-maintaining productive plants such as nut trees.

As a living, practical example of the kind of society that he has in mind, Trainer described in a newspaper article a farm community that he visited near Lismore, NSW, on the edge of 'The Big Scrub', which was once Australia's largest rainforest. The community occupies a farmhouse and a number of smaller houses, all built by community members from local materials and dotted round a very beautiful valley. They produce most of their food, including tropical and subtropical fruit and vegetables, and one of their main aims is to restore the forest; they are planting eroded slopes with native rainforest trees. All decision-making is by consensus and all members have a strong sense of mutual responsibility. Most have part-time jobs outside the farm, though, owing to their high degree of self-sufficiency, there is not much pressure to make money. In Trainer's opinion: 'Without doubt they have a far higher quality of life than the average Australian – achieved on an outlay around one tenth the national average income!'

From Lismore to Lightmoor is to cross from the other side of the world – from 'Down-under' almost to my own doorstep – for the Lightmoor community has been established in a wooded area on the western fringe of Telford New Town. Both communities have much in common, above all the practical, no-nonsense, down-to-earth, pioneering spirit of the participants.

Lightmoor community comprises fourteen houses, all individually designed and built by their owners and all with 'passive' solar heating features, surrounding an embryonic village green. On three sides is woodland, fourteen acres of which is a conservation area to be managed by the villagers, who also share an acre of communal growing land and a wet meadow. Each family has a half-acre plot and I was told that six families thought of starting forest gardens. The community, which constituted itself a limited company, acquired the land, twenty-three acres, at a knock-down price from Telford Development Corporation, on condition that they built the road and drains themselves. That meant hard manual labour every weekend for three years before work on the houses could begin. But there is nothing like digging at the bottom of a three-foot trench on a cold winter's day to foster a community spirit. Among Lightmoorians one senses a pride and comradeship born of common achieve-

ment in the course of seven year's hard slog. This has been a great help when conflicts and personality clashes have occurred, and when it has been necessary to take hard decisions. The whole project has been an excellent training ground in grassroots democracy, and mutual assistance is the keynote in many ways, small and large. While most residents have away jobs, possibilities are brewing for partnership enterprises in the village. Residents share a sense of far-reaching potentialities and also of security in the face of an uncertain future, derived from built-in alternative strategies.

A sense of deep emotional and spiritual unity, rooted in common ethnic-ecological traditions, is the cement that maintains the structure of a very different community in New York state: Crows Hill Farm, the home of the Indigenous Permaculture Network of Native Americans. Katsi Cook, a Mohawk, who founded the community with her husband Jose Barreiro in 1986, describes the well wooded landscape as 'just the place for developing an old-style Indian homestead, a place for Indians to gather and for our young people to experience something of their ancient culture'. Among the community's main aims is to restore traditional Indian farming systems, including the companion planting of maize, beans and squash. These crops, known to Iroquois as the 'three sisters', are mutually compatible: the squash vines act as a living mulch, suppressing weeds, while the maize stalks support the beans, which fertilise both themselves and their companions with airborne nitrogen. This interaction is typical of the ecological concepts employed in permaculture-agroforestry. Stephen C. Fadden, another Mohawk, has written: 'Permacultural concepts are not foreign to people who come from a Native American tradition. The idea of land sustaining the people and the people holding the land in deep respect and care, underlies the basic world perspective of most Native American communities and philosophies.' As another member of the Crows Hill community puts it, 'Living in harmony with nature, living gently on the earth, by taking only what is necessary for life and giving in return, is the underlying philosophy of both permaculture and traditional Native American peoples.'

A similar understanding and respect for the products of Mother Earth, of Gaia, in all their complexity, is typical of many of the people of south-east Asia, especially, the inhabitants of the forest villages of Java.

Forest villages have existed for over 1,000 years in Java, where they ensure that one of the most densely populated rural areas in the world is also a landscape of great beauty. A forest village in the Javanese sense is a village built out of local materials, screened and protected by a ring of forest gardens, which supply many of the inhabitants' basic needs. The for-

est gardens, like others in the region, are multi-layered structures supplying a wide range of products. As many as 250 different species of crop-plant have been found growing in and round a single village. The Javanese enjoy an extremely varied diet, including more than 500 different plant foods.

In recent years forest villages have been established in Thailand, in an effort to bring stability to the lives of shifting cultivators and limit the damage they have done to the environment. Families who agree to give up shifting cultivation are allotted plots on which to build houses and establish homegardens, and are also allowed to grow crops within new forest plantations. They also receive free electricity, drinking water, medicines, transport and education, as well as payment for plantation work.

This forest village system has proved successful, not only in Thailand, but also in Cambodia, India, Kenya, Gabon, Uganda and Nigeria.

Advocates of a post-industrial world order, geared to the satisfaction of human needs and the development of whole human beings, from Gandhi to the Greens, have postulated that the basic unit of such an order should be the decentralised, democratic, self-sufficient rural community. Surely the most attractive as well as the most effective setting for such a community would be the forest village, encircled by forest gardens. These would not only provide food, timber, fuel, energy and craft-materials for the villagers, but also beneficent microclimates, shelter from wind and storm, pure air and reasonably assured supplies of pure water. Many rural areas in every country, not least Britain, are little better than featureless wildernesses, bereft of trees by sheep and shipbuilders, mineral workings and motorways, muirburn and prairie farming. Far too often human activities have brought ugliness, desolation and pollution to the countryside.

But this has not always been so. There is no reason why human activities should not make the countryside more beautiful than ever before, with new forms, new colours, new rhythms, and a vastly increased diversity of plant life, which would, in turn, attract an increased diversity of animal life. This would be a real countryside, designed to satisfy the real needs – rather than artificially stimulated 'wants' – of human beings; not only physical needs, but also emotional and spiritual needs. The fortunate dwellers in such a countryside would not want to indulge in war and other anti-social activities, but would, as parts of the ecosystem, automatically conform to its law of cohesiveness. And such a countryside would also create its own culture: new colours and sounds, new sights and insights, new senses and sensitivities, new challenges, new chords and discords, new conflicts resolved. Walter and Dorothy Schwarz in *Breaking Through* write:

> When the shift to a more wholistic style of life becomes more widespread, one of the most exhilarating developments will be the part that art will play in everyone's life. By art we mean, not a narrow interpretation of pictures seen in a gallery, programmes watched on television or costly performances of nineteenth century operas. We mean all the performing and creative arts and the artefacts, pots, chairs, rugs which people create for themselves.
>
> Art can be used as a metaphor for society. Our arts reflect our involvement with, or our alienation from the world around us... In primitive societies art, everyday life and religion are so intertwined that there is little separation. Music, dance, pottery, carving and weaving are accessible to and created by everyone.

Progress is a spiral; the pendulum swings back as well as forward. The new post-industrial world, for which many of us are striving, will see an ecological Renaissance, a rebirth of all that was best in 'primitive' life and outlook, blended with new potentialities at which we can only guess.

Chapter Thirteen

Where Do We Go From Here?

The Wenlock Edge Project was born of a desire to achieve the highest possible degree of self-sufficiency throughout the year in a limited space with minimum labour. For the benefit of any who might wish to start a similar venture, this short chapter gives a summary of the necessary steps, based on many years' experience, many trials and some errors.

It must be emphasised at once that, in temperate zones, little or no fresh produce can be gathered from the forest garden during the winter months, as the trees and bushes cease fruiting and herbs and perennial vegetables die down. Hence the need for a winter garden of hardy annuals to supplement the forest garden. In my own case, this is one of the functions of the Ante(i) Forest Garden. Another function is to grow plants that are antagonistic to forest garden conditions: sun-loving herbs and *Vaccinium* species that require lime-free soils.

The primary *raison d'etre* of the whole venture, as far as I am concerned, has been health. Having made a very deep study of natural health and healing, I have long been convinced that the most effective diet for all-round positive health is one containing a preponderance of fresh or naturally dried fruit, vegetables, nuts and herbs. I also believe that a *wide diversity* of such foods is desirable. The human system, like other living organisms, is immensely complex, and, for optimum efficiency, clearly demands an extensive range of nutrients. Nutritional science has, in recent years, discovered a number of trace-elements that go far beyond the generally recognised requirements of proteins, carbohydrates, vitamins and minerals. There can be little doubt that other factors remain to be uncovered, factors that may well be the key to the prevention and cure of serious illness. A vast amount of research remains to be done into the full potentialities of plant life. Only about one per cent of known plant species have been subjected to exhaustive scientific scrutiny. Little is known even about the nutritional and medicinal contents of some of our commonest 'weeds', plants that in less sophisticated and affluent times and societies have been major constituents of diet and medical care.

Every species of plant, even every variety of every species, has a differ-

ent biochemical make-up, and therefore probably has a different contribution to make to the holistic health of the human system. For this reason, I am firmly convinced that the boundaries of diet should be extended far beyond the range of products available in the shops. Hence, in my case, the Wenlock Edge Project; though I must emphasise that the products of a single home self-sufficiency scheme, however diverse, are not likely to be fully adequate for optimum human nutrition. Also one should not underestimate the legitimate pleasures of gastronomy, which in some countries, such as France, Italy and China, attains the status of a fine art. Food that tastes good tends to be good for you. I well remember the spirit of reverence with which my mother's singing master, Ernesto Baraldi, savoured the dishes which my mother had carefully prepared for his enjoyment at our Kensington dinner parties – another world from Wenlock Edge!

Those in temperate countries who enjoy gastronomic exploration naturally find themselves drawn to the delicious and exotic dishes of the Mediterranean and the Far East. But it is more exciting still, and even more healthful, to devise one's own recipes consisting of unusual fruit, vegetables and herbs grown by oneself – and/or one's neighbours. For this reason, members of health clubs and other concerned people might care to establish forest gardens and winter gardens of complementary plants, so that they can exchange surpluses. Some adventurous souls might even consider embarking on joint projects like the Lightmoor Community, described in Chapter 13, for the supremely important goal of attaining the rare treasure of positive, lasting health. For such people a considerable amount of help and guidance is now available in Britain.

The Neighbourhood Initiatives Foundation (NIF) was set up in 1988 by the Town and Country Planning Association and the Housing Association Charitable Trust to 'work with communities that have set out to help themselves'. Basing itself on the achievements of the Lightmoor Community, it aims 'to improve housing, local environment, livelihoods and community facilities'. Following seven years of field research at Nottingham University, the NIF has issued more than forty 'Education for Neighbourhood Change Packs', containing three-dimensional models which can be switched around, so as to enable people to visualise the kind of environment and facilities they would like, such as communal gardens and co-operative enterprises. For full information, NIF can be contacted at Chapel House, 7 Gravel Leasowes, Lightmoor, Telford, Shropshire TF4 3QL. Similar packs have been issued by government-sponsored organisations in Holland, Germany and Australia.

Self-sufficiency projects, of course, need not be restricted to food and

healing herbs. Among other products of a forest garden system can be fuel for wood-burning stoves, timber for fencing, stakes, carving and turnery, fibres for spinning, weaving, matting and basketry and aromatic herbs for moth-proofing. In addition to my osier coppice, cut for basketry, Garnet coppices other willows in the arboretum and passes them, together with hedge-clippings, through the 'Viking' shredder to produce material for mulching, composting and fuel. Coppicing is an excellent and well-tried form of sustainable woodland management. The stumps of appropriate trees do not die when the trees are felled; instead dormant or adventitious buds regenerate new shoots. This allows repeated harvests without the trouble of replanting. Meanwhile the ever-growing root network maintains soil structure and ensures that re-sprouts grow far more vigorously than rootless cuttings or seedlings or saplings with merely embryonic roots.

My whole project area, except the arboretum, is kept permanently mulched throughout the year. This not only suppresses weeds but also fertilises the land as the mulch rots down and maintains near-ideal conditions for both plants and soil organisms. Of special importance at times of drought is that a mulch of straw remains surprisingly moist for weeks on end. Wood shreddings are a good substitute for peat, which we are being urged by conservation bodies not to buy, as peat bogs are a valuable but dwindling wild-life habitat.

The permanent mulch cover makes it unnecessary to disturb the soil by digging or hoeing, except, of course, when planting and in the initial preparation of the ground. This is the only time when really hard work is necessary. If the site is, say, old pasture, as mine was, then it has to be thoroughly dug over and the soil thoroughly worked before planting. This can also be done with a mechanical cultivator, which can be hired, as no such machinery will be required after the initial phase. Before planting, it is a good idea to sow a green manure crop such as mustard or tares, which will be killed off by the first frosts and thus leave the soil in a rich, friable condition for the fruit or nut trees or bushes.

The trees in the arboretum were planted in holes dug and filled with compost in the old pasture. This is 'flymowed' every two or three weeks throughout the spring, summer and autumn, which has had a remarkable effect in improving the quality of the sward. As a result of regular cutting, the most obstinate weeds, such as docks, with which the pasture was infested, have simply disappeared, to be replaced by tender grasses and clovers.

An old orchard makes a very good nucleus for a forest garden, unless the trees are severely diseased. My forest garden was planted in a twenty-

five-year-old small orchard of apples and pears, some of which were in a pretty poor condition. But the abundant aromatic herbs that have been planted beneath them seem to have rejuvenated them; a decrepit-looking Red Ellison apple was given a new lease of life when Garnet grafted three young King of the Pippins shoots on to it – a trick that was known to the Romans. These old trees constitute the 'canopy' of the forest architecture. If one is starting one's forest garden from scratch, the best way to form a canopy is by planting standard apples, plums or pears at the recommended intervals: twenty feet each way. Then fruit or nut trees on dwarfing rootstocks can be planted half-way between the standards, to form the 'low-tree layer', and fruit bushes between all the trees to form the 'shrub-layer'. Herbs and perennial vegetables will constitute the 'herbaceous layer', and horizontally spreading plants like dewberries and other *Rubus* species, as well as creeping herbs such as buckler-leaved sorrel and lady's mantle, will form the 'ground-cover layer'. For the root-vegetables, mainly radishes and Hamburg parsley, occupying the 'rhizosphere', a low mound can be raised, so that they will not be swamped by the herbs. As for the climbers that constitute the 'vertical layer': vines, nasturtiums and runner beans can be trained up the trees, while raspberries and hybrid berries, such as boysenberries and Tayberries, can be trained over a trellis fence forming a boundary to the garden.

Other possible boundaries to a forest garden are: a trellis fence adorned with espalier, cordon or fan-trained fruit-trees; a 'Bouché-Thomas' apple hedge, with the trees planted diagonally so that they grow into each other; a hedge of dwarf apples and pears planted at five-foot intervals; a hedge of blackcurrants planted at three-foot intervals, or an old-fashioned English multi-species hedgerow, comprising elders, crabs, bullaces, damsons and hazels, with blackberries, honeysuckle and eglantine sprawling over them.

If rabbits are rife in the neighbourhood, it is a good idea to encase the more valuable and delicate saplings in plastic tree-guards, though a hedge of perennial onions is said to be an effective rabbit deterrent. To provide shelter for young trees against the prevalent wind, it may be necessary to erect a strong fence or a row of hurdles, or plant a windbreak of fast-growing Leyland cypresses.

The lay-out of the forest garden should preferably not be a regular square or rectangle but should adopt an interesting, rhythmical form in tune with the environment. When we come to questions of 'significant form' and the precise placing of plants in relation to each other, we enter an intuitive, aesthetic realm which, to the down-to-earth horticulturalist or agricultural scientist, may savour of mystification.

Western agronomists, having until recently dismissed the arrangement of tropical forest gardens as 'haphazard' or 'chaotic', now seem to regard them, with a mixture of cynicism and awe, as 'mysterious', like the orthodox reaction to organic growing as 'all muck and magic'. A Western scientist working at ICRAF, John B Raintree, asked in a conference paper: 'Is it that... seemingly haphazard combinations of such diverse components in the tropical homegarden or other 'forest-like' associations in traditional agroforestry lacks rational order, or is it that the traditional farmer in the tropics responds to different cannons of rationality?' Then he went on to answer his own question by quoting from another Westerner's treatise on African agriculture, and saying: 'De Schlippe's genius was to recognize that far from being devoid of order and rationality, the hidden order behind the seeming chaos of traditional agriculture in the tropics is the order imposed by nature itself. Does anyone... really question the rationality of nature?' Quoting de Schlippe again: 'It can be seen now that the seeming disorder of Zande fields and courtyards (forest gardens) is due to the fact that the Zande embroiders his agricultural activity on a canvas and pattern provided for him by nature.' Later the scientist commented: 'If the patterns that result resemble the complexity of nature itself, that may be, not an accident of culture, but a deliberate strategy for achieving a sustainable or even a 'regenerative' agroforestry.'

All this amounts to an admission that a forest garden is not an 'unscientific' or 'antiscientific' structure, but that it obeys an order decreed by ecological laws which Western science has not yet fully identified. The tropical gardener, by a combination of intuition, insight and observation, in the course of intimate caring for his plants, has learnt many facts about their nature, requirements, interrelationships and laws of growth which escape the scientist with his microscope and test-tubes. The same, of course, applies to temperate forest gardens. If they are productive, it means that they are activated by energies and conform to symbiotic relationships which await scientific confirmation. Like the tropical gardener, we who create our own forest gardens must not be afraid to trust our intuitions when deciding on the placement of different plants. If we envisage the vast complexity of the root network, while also observing the channels by which air and sunlight penetrate the canopy, we are likely to be led to select the right position for our introductions.

The whole question of symbiotic relationships, not only between plants, but also between plants and animals, is a vast and complicated subject which needs years of scientific research.

As far as the plant-insect relationship is concerned, it is important to ensure that all the fruit trees in a forest garden, if not self-fertile, are com-

patible for pollination purposes. This means that each tree must have a nearby neighbour that blossoms at approximately the same time. When buying fruit-trees it is most desirable to ask the nurseryman if they are compatible or self-fertile, or carefully to scrutinise the catalogue which should give this information. Most ornamental crabapples, while being very attractive in their shapes and colours, make excellent pollinators for their ordinary cousins. Golden Hornet above all, which, as its name implies, gives a glorious display of gleaming fruit throughout the autumn, is said to be an effective pollinator for almost all ordinary apples.

When buying plants it is best, if possible, to go to a local family-run nursery, where one can be reasonably sure of finding reliable stock suited to one's own climatic conditions. Then one can buy what really appeals to one; buying by mail-order often results in disappointments. It always pays to go for quality, even if that means paying rather higher prices. A really strong, healthy, robust and interesting plant will be a good friend for years, constantly rewarding one with fascinating and unexpected developments. Plants of rare species or trained in special shapes, such as cordons, espaliers and fans, tend to be much more expensive than more ordinary plants, which can be just as interesting in their own ways, and often more healthy and productive. However, if space is very limited it is worthwhile investing in one or two 'family trees' or 'Ballerinas', expensive as they are. A family tree comprises anything from three to six different varieties of fruit on a single rootstock. A Ballerina is a newly introduced form of apple or crab, in which the fruit grow very close to the stem, so that the tree, which may grow to a height of eight feet, occupies a minimum of lateral space.

When I learnt that Bill Mollison intended to visit me in October 1990 with an Australian TV team, I launched out into buying all the most interesting and showy trees, shrubs and herbs that I could lay hands on in the neighbourhood. Among them was a glorious Golden Hornet and a Ballerina crab called 'Maypole'. A few bright, colourful ornamentals greatly enhance the appeal of a forest garden layout. Ornamentals tend to be more expensive than fruit trees and bushes, though cheap bedding plants, scattered here and there, can also add gay patches of colour. I usually plant *Tagetes* – French or African marigolds – *passim* at the beginning of the season, not only for their brightness but also because they are believed to be good companions to other plants, deterring aphids and nematodes. For winter colour, nothing can equal pansies, which are now available in a fascinating range of colours and patterns. They are believed to have medicinal virtues and may have been used in love-potions in the past, to judge by some of their attractive Elizabethan names: 'Heartsease',

'Johnny-jump-up-and-kiss-me', 'Kitty-run-the-streets', and – most elaborate of all – 'Call-me-to-you-Jack-behind-the-garden-gate'!

A good excuse for planting ornamentals is that they attract beneficial insects, which are important components of the forest garden system. One of the basic aims of agroforestry is to integrate conservation with the growing of food and other useful products. Agroforestry/permaculture is a holistic concept designed to serve whole human beings – in fact, the whole of life. The beauty of birds and butterflies, moths and dragonflies feeds the human soul as much as fruit, nuts and herbs feed the human body. I shall never forget the sudden revelation, in the summer of 1989, of coming upon the deep purple buddleia on the rose-mound in the arboretum, teeming with a multitude of many-coloured butterflies. No scene in a tropical forest could have been more beautiful. It was an experience of a lifetime, a reward for years of hard labour.

A forest garden is not a static thing, it is a complex *living* organism which means a developing organism; it changes from year to year, even from day to day. I would urge anyone who starts a forest garden to adopt a creative attitude towards it; to learn and observe, to study and do research. Humankind has an enormous amount to learn about plants, above all about their relationships between each other, and the amateur can make as important discoveries by observation and experiment as can the trained scientist with his disciplines and instruments. In fact the work of the two bodies can be complementary. The peasants who have founded and fostered the centuries-old forest gardens of the tropics have an intimate knowledge of their soils and plants, reinforced by traditional lore inherited from their ancestors, which is beyond the conception of most western gardeners. Their plant knowledge is based on empathy; they *feel* the characteristics, needs and aspirations of each individual plant: 'That young tree wants a bit more light; I must cut a gap in the canopy to let some more sunshine through.' And this intimate knowledge, combined with loving care for the plant's welfare – and also, in many cases, with the bitter realisation that the very survival of the peasant and his family depends on that welfare – leads to insights, intuitions and 'hunches', the truth of which only science can confirm. For instance, I recently noticed that a clump of raspberry canes growing out of a bed of nettles seemed to be particularly thriving; they were more vividly green than their neighbours, they radiated health and vigour. Was that a confirmation of the traditional lore that nettles, under conditions of controlled growth, can be good companions? Only science can give a definite answer. Root secretions and gaseous aromas can be analysed, to ascertain whether nettles do in fact emit substances that fertilise and stimulate their neighbours and

possibly ward off pests and disease germs. A partnership needs to be built up between gardeners, peasants and scientists, to find out answers to many questions like these, on which the very future of large sections of humankind may depend. At this time of ecological crisis, of man-induced erosion, of wholesale environmental destruction caused by burning and bulldozing, flooding, chemicals and industrialisation, salvation for millions of people must lie in the re-creation of intensive systems of horticulture to meet their essential needs.

Many of us, however small our gardens and however limited our qualifications, can participate in this vital movement. The humble black American scientist George Washington Carver developed more than 300 products from one humble plant, the peanut. We can all experiment with new recipes, new salad combinations, possibly new craft-uses for plants, such as the extraction of dyes by boiling. We can allow annual vegetables to fulfil their life-cycles and test the palatability of their flowers, fruit and seeds. We can propagate fruit-trees from seed, and, with patience, may develop new, more delicious, more nutritious varieties, as apples, in particular, never 'breed true' from their pips. Some of the best known apple varieties have been 'pippins', including the famous Cox itself, bred by amateur gardeners.

A forest garden, whether in a London suburb or on a tropical hillside, can be a matrix of creative living, of holistic development, where women, men and children can imbibe health through every sense, and engage in vital, constructive activities as parts of a wider ecosystem. Dare one say that it can be a microcosm of a new, post-industrial world order?

It is less than 150 years since the Industrial Revolution began to spread its blight across Europe and America. Before that, humankind had satisfied almost all its basic needs direct from Mother Earth: from the fields and forests, orchards, market gardens and vineyards, quarries and unpolluted waterways. The lack of man-made technology had not prevented humanity from reaching the highest peaks of culture. So there is no need to feel anxiety or regret about the imminent decline and fall of the Industrial Age, however many discomforts and dislocations it may involve. We can look forward to a new twist in the spiral of world progress, when much that is best in the past, such as many forms of traditional agroforestry, are re-discovered and find new applications in the light of modern science, while being combined with what is best in modern technology, mainly in its 'appropriate' or 'intermediate' forms.

For those with eyes to see, this Ecological Renaissance is already in progress. In moving away from the machine and all it stands for, human beings must come to realise that the 'miracles' achieved by physical sci-

entists and engineers can be dwarfed when more attention is focussed on the infinite potentialities of Life.

Since the publication of the first edition of this book, forest gardens have been springing up in many parts of Britain and other countries. Of special significance for the future pattern of world development in this millenial era have been the efforts of some towndwellers to reverse the urban invasion of the countryside by creating green oases in inner city areas.

London's first communal forest garden was started by a cosmopolitan group called Naturewise in Crouch Hill, near the home of my Spanish Basque grandfather Nicasio Emigdio Jauralde, who served as a financial representative of the Spanish government in London for the astonishing period of seventy-two years.

The group, led by a Turkish Cypriot, Alpai Torgut, acquired from the local council a steep, south-facing bank, created out of rubble when some houses were demolished after the Second World War. It was covered with grass, with a few old trees, and daffodils grew there in the spring. The group, together with local helpers, dug out three terraces, supported with wattle fencing, and with two 'swales' to each terrace for irrigation. These were mulched with compost and leftover fruit and vegetables supplied by the local greengrocer, and planted with a wide variety of fruit trees and bushes, with fragrant herbs as ground-cover. By the first summer, wild-life were seen, in the form of nesting blue-tits, butterflies and bees.

By then, local residents were beginning to take an interest, especially when they learned that the forest garden was for all. 'We felt that they were rediscovering their own connection with nature,' Alpai remarked. Though there was some vandalism, the group maintained a non-confrontational, *ahimsa* attitude towards everyone and gradually a community spirit has emerged. There have been encouraging signs of negative factors, such as destructiveness and depression caused by unemployment and poverty, being transmuted into collective creativity, as more and more local people have become involved with nature in building a local resource of value to them all. In time the forest garden will provide an abundance of fruit, vegetables and herbs as well as the soul-food of beauty.

In particular, the project has brought happiness to many children, and in 1995 the group were asked to make a second forest garden in the grounds of a day nursery named after Margaret McMillan, who believed that children achieved a far higher degree of self-fulfilment, if they had constant contact with nature.

Other forest gardens have been created or planned in or near Man-

chester, Middlesbrough and Coventry.

A particularly impressive forest garden is being created by Martin Crawford of the Agroforestry Research Trust on the Dartington estate in south Devon. A very wide diversity of fruit and other economic trees, bushes and herbs are being planted in carefully worked-out layers or 'storeys'. Martin reckons to make the project self-fertilising by planting a large number of nitrogen-fixing trees and shrubs, as well as 'dynamic accumulators' – deep-rooting perennials such as sorrel, comfrey and colts-foot, which draw up phosphates and potassium from the subsoil and make them available to other plants. Ultimately, Martin hopes that the garden will contain 35,000 plants!

Epilogue

A New Twist in the Evolutionary Spiral

Over the years, people from many countries have been to visit the forest garden on Wenlock Edge. A number have spoken of making forest gardens of their own. Speaking to such people gives me great hope for the future of the world. I can detect signs of the evolution of a new breed of human being. *Homo sapiens* is developing into *homo altruisticus*.

A spiral combines an upward thrust with a pendulum swing. The next development in humanity does not only involve new technologies, new outlooks, new modes of thought. It must also entail a readiness to look very far 'back' – to tribespeople whom western 'civilisation' dismisses as 'primitive', even to our nearest relatives in the animal world, the anthropoid apes and the woolly monkeys of the Amazon rainforest.

Among enterprises, families and communities that have recently embarked on the adventure of forest gardening is the Monkey Sanctuary near Looe in Cornwall. Founded by the musician and philosopher Leonard Williams, the sanctuary expresses the one supremely important quality which must characterise the woman and man of the New Age: *compassion*. Most of the vast toll of suffering, which is one of the dominant features of today's world, could be avoided and healed if more people learned to *care* about their fellow-beings, animal and human.

In the 1950s and 1960s, the woolly monkey (*Lagoethrix lagotricha*) was regarded as a particularly attractive pet, and thousands were taken from their homes in the rainforests of South America and brought to Britain to be kept as pets or in zoos. Denied the communal life which is essential to their wellbeing, those intelligent and sensitive animals developed psychic disorders and lived tragically short lives.

Leonard Williams, who lived with his wife June at Chislehurst near London, was one of the many people who kept woolly monkeys as pets. With the hypersensitivity of the musician, Len realised intuitively that his pets would never really thrive unless they were given the space and freedom to develop their natural social instincts. In 1964, with his family and

his monkeys' keeper Sue Rickard, Len established the sanctuary in Cornwall, which is designed in every possible way to enable the animals to lead natural lives. He also appealed to pet-owners and zoos to let him have their monkeys, so that they could be properly looked after and, when possible, returned to their jungle homes.

Now the sanctuary comprises a colony of happy, healthy, animals living in an environment carefully designed to fulfil their every need and looked after by a co-operative human community. Recently the community decided to start a forest garden, comprising a wide diversity of fruit trees and other edible plants for the consumption of both animals and humans.

Another, quite different co-operative community, which is also engaged in forest gardening activities, is the Centre for Alternative Technology near Machynlleth in Wales. Situated in a disused slate quarry, this fascinating establishment has been developed by people who *care* – about the fate of human beings and the environment. This has led them to produce and display a large variety of devices carefully designed for sustainable and non-pollutive living. The Centre's history, as related in *Crazy Idealists* (C.A.T., Machynlleth, 1995) is an inspiring tale of vision, courage and devotion, of hardship, heartbreaking struggle, comradeship – and enormous fun – played out in the beautiful, well wooded surroundings of a Welsh valley.

Quite different again is the achievement of a young couple, Pam and Peter, who have created a highly productive garden, partly designed on forest garden lines, on an almost precipitous hillside on the outskirts of the North Lancashire mill town of Todmorden, close to the Brontë country of the Yorkshire Moors. Pam Colbran is an attractive, talented Lancashire lass, a schoolteacher, and Peter Two Bulls is of native American origin, an initiated member of the Oglala Lakota tribe. In the heavy clay soils of that cold northern hillside, which they have terraced for ease of working, Pam and Peter have planted an amazing selection of fruit, vegetables, herbs and flowers – some choice, some very rare. They include greengage, cherry, medlars, Japanese wineberry, boysenberry, tayberry, cape gooseberry, huckleberry, wild service tree, liquidamber, gingko, *gaultheria procumbens*, asparagus, cardoon, Chinese cabbage, papillon lavender, and – rarest of all – Hopi blue corn, Hopi pinto beans and 'mummy' peas. The latter, which are descended from seed found in an Egyptian tomb of 4,000 years ago, make tall, vigorous plants. In all, the garden contains more than 200 plants. From Pam's observation, she finds that an apple tree surrounded with tansy plants – a traditional association – thrives better than an apple with no tansy nearby. She uses some of the

herbs for medicinal purposes. Trees are grown to stabilise the very steep slopes.

William James, the famous American philosopher and pioneer of the science of psychology, in an essay entitled *A Moral Equivalent of War*, pointed out that the instinct for violence and the joy of conflict were deeply ingrained in the masculine psyche; but that they could be transmuted into a wholly positive and peaceful dynamic. This book contains many examples of men – and women – who have successfully achieved this drastic internal revolution. Such people are the men and women of the New Age.

Vast tasks, calling for all the courage, discipline, dedication and ingenuity commonly associated with war, will have to be carried out if the majority of humankind are to survive and enjoy a tolerable future. These tasks include the reclamation of deserts and desolated areas, such as mining spoil-heaps, by agroforestry means. The techniques are well known. First the ground is prepared by the planting of hardy, drought-and-pollution-resistant 'nurse-trees'. These then act as protective screens for more tender but more valuable economic plants. Even in grossly degraded former rainforest areas in Amazonia, courageous colonists, some of Japanese origin, have successfully created forest gardens and other agroforestry plantations. Richard St. Barbe Baker, the original 'Man of the Trees', had a stunning vision of a reclaimed Sahara, capable of providing homes, gardens and livelihoods for three and a half billion people.

The new settlers could include many of today's tragic refugees, men, women and children uprooted by war, natural disaster, or flooding caused by the building of big dams. In his autobiography *My Life My Trees*, Richard wrote: 'Is it too much to hope…that the Iron Curtain of the world will give place to the Green Front and the scars in the earth as well as the scars in people's hearts may be healed by tree-planting?'

Appendix One

Temperate species and varieties recommended for Wenlock-Edge-type self-sufficiency scheme: Forest Garden, Winter Garden, and Wetland Garden

FRUIT & NUTS

APPLES (*Malus domestica*)

LATE SUMMER DESSERT APPLES

Ripening in July, August, or early September. Do not keep for more than ten days after picking.

Devonshire Quarrendon – Historical fruit recorded before 1650. Dark crimson with green patches. Crisp with distinctive flavour.

Discovery – Successful modern variety bred by amateur. Bright scarlet, juicy and resistant to scab.

George Cave – Earliest of all. Mine cropped so heavily in summer drought 1990 that branches had to be supported by scaffolding to prevent them from breaking.

EARLY AUTUMN DESSERT APPLES

Ripening in September, some keeping till October.

Ellison's Orange – Of Cox parentage. Taste described as 'aromatic aniseed'. Does well on light, sandy soil.

James Grieve – Of Scottish origin, so does well in the North. Taste described as 'brisk'. Juicy and handsomely striped.

Katja – A Swedish cross between James Grieve and Worcester Pearmain, so very hardy. Bright crimson and prolific cropper. Sold in shops as 'Katy'.

Laxton's Fortune – Of Cox ancestry. Crisp, juicy and sweet. Resistant to frost and scab.

LATE AUTUMN DESSERT APPLES

Ripening in October, keeping till November and December.

Allington Pippin – Vigorous and self-fertile. Rather sharp-flavoured. Used for my Bouché-Thomas hedge.

Charles Ross – Big and juicy. Does well on chalk and by seaside. Resists scab.

Egremont Russet – Most popular of the russets, with characteristic musky flavour. Self-fertile and disease-resistant.

Greensleeves – New James Grieve x Golden Delicious cross. Crisp and sweet.

King of the Pippins – Also known as Shropshire Pippin. Said to have 'highly aromatic almond flavour'.

Sunset – My favourite and many other people's. Crisp, hardy member of the Cox stable. Has characteristic 'setting sun' marking on tip.

Tom Putt – Bred by Dorset parson of same name around 1700. Described as 'large, crisp, acid, with vivid red stripes'.

MIDWINTER DESSERT APPLES

Ripening November, keeping till January or February. Best picked in October.

Kidd's Orange – Cox seedling from New Zealand. Less delicate and more disease-resistant than its parent.

Pitmaston Pine Apple – Eighteenth century, believed to be descendant of Golden Pippin, which was the most favoured apple in Elizabethan days. Small, crisp and amber, with distinct pineapple flavour.

Ribston Pippin – Strong and vigorous, one of the most richly flavoured, aromatic apples. A parent of Cox.

Spartan – Of Canadian origin, therefore very hardy. Deep purple, almost black. Garden-grown Spartans are crisp with a rich port-wine flavour, streets ahead of the flabby, tasteless shop products.

NEW YEAR DESSERT APPLES

Ripening in December or early January, keeping till February or March. Should be picked before hard frosts.

Ashmead's Kernel – First raised by Dr Ashmead of Gloucester before 1720. Russet type, voted as best-flavoured of all apples.

Jupiter – A recent release from East Malling. According to Deacon's catalogue: 'Aptly named Jupiter as fiery red with gold stripes'.

Suntan – One of the newest of apples with one of the most ancient as its parent: cross between Cox and Court Pendu Plat.

Winston – An improvement on the popular Laxton's Superb. Described as more 'briskly' flavoured.

SPRING DESSERT APPLES

Ripening in December and January, and keeping till spring.

Court Pendu Plat – Possibly the oldest of all cultivated apples, going back to Roman times. Known as the 'wise apple' as it blossoms after the last frosts.

Sturmer Pippin – Essex apple widely grown in Tasmania and New Zealand, with unique sweetness of flavour.

Tydeman's Late Orange – Yet another Cox offspring with true Cox flavour but exceptionally crisp.

LATE KEEPING 'COOKING' APPLES

Annie Elizabeth – Longest keeping of all English apples: can last till July.

Bramley's Seedling – As good eaten raw in salads as in Mum's apple tarts.

Flower of Kent – Specimen was in Sir Isaac Newton's garden at Woolsthorpe, Lincs, in 1660; it is believed that this tree inspired the Theory of Gravity!

Howgate Wonder – Probably the largest of all apples. Sweet, crisp and worth eating raw.

CRABAPPLES (*Malus pumila*)

The flowering crabs are short, neat trees which are very suitable for the low tree layer of a forest garden, where they are first-class pollinators of the ordinary apples that are their neighbours. Many of them produce prolific crops of fruit, some of which are surprisingly palatable and, I am sure, rich in minerals and vitamins. One of the main aims of the forest garden project is to enable families greatly to extend their diets, by including wholesome, natural foods that are not available in the shops.

Crittenden – Notable for its heavy crops of bright scarlet fruit which persist throughout much of the winter. Fruit just right for eating off leafless tree after heavy frost.

Golden Hornet – As its name implies, gives prolific crops of gleaming gold fruit. Said to be the best pollinator of ordinary apples.

John Downie – Exceptionally attractive, comparatively large, egg-shaped fruit, golden with orange-scarlet cheeks, and with a most intriguing flavour.

Red Glow – A splendid little tree with leaves that turn red in the spring and green in the autumn! Crimson blossoms followed by crimson fruit.

PEARS (*Pyrus communis*)

Can be divided into down-to-earth English varieties and highly scented

epicure fruit bred by wealthy amateurs in France and Belgium in the eighteenth and nineteenth centuries.

Beurré Hardi – Reddish fruit of interesting sub-acid flavour but rather harsh texture. Very vigorous grower and scab-resistant.

Conference – Reliable but tasteless.

Doyenne du Comice – Large, juicy fruit generally acknowledged to be the queen of pears.

Glow Red William – Bright red fruit whose colouring is claimed to make it resistant to weather and fungus diseases.

Hessle – Tree with small russet fruit named after the Yorkshire village where it was bred. A 'no nonsense' fruit like the people of its native county.

Improved Fertility – From my experience the most reliable cropper of all pears. The centre-piece of my first experiment in agroforestry. Seems to have thoroughly enjoyed the companionship of the red, white and black currants, raspberries and herbs that have surrounded it. Fruit small, russet, sweet and none the worse for being rather rough.

Jargonelle – An ancient pear of high quality first recorded about 1600. As hardy as Hessle and will succeed in the same bleak, northern environment.

William's Bon Chrétien – Best known pear in England and, to my mind, overrated.

Winter Nelis – A very late pear, greenish-yellow and heavily russetted. Flavour, to my mind, underrated.

PRUNUS SPECIES

A large and valuable genus which includes plums, peaches, apricots and cherries. I have had little experience of any of them except plums, which include damsons and gages.

PLUMS (*Prunus domestica*)

Coe's Golden Drop – Said to be the 'Cox of Plums'. Golden fruit with reddish-brown spots and apricot flavour. 'Melts in your mouth', said the nurseryman, but I wouldn't know: my tree has never fruited.

Czar – Reliable, early, heavy-cropping, black fruit said to be good only for cooking, but I disagree.

Kirke's Blue – An epicure fruit, large, sweet and violet-red, but poor cropper.

Marjorie's Seedling – The latest of all plums. Stays on the tree till December unless there are frosts. Another underrated fruit. Vigorous and self-fertile.

Opal – A newish early variety raised in Sweden. Good dessert quality.
Purple Pershore – Yet another underrated variety. Firm, meaty, enjoyable fruit, too good for jam.
Rivers' Early Prolific – Small violet-purple fruit. A hardy little tree.
Victoria – Needs no description, as they say. Britain's favourite plum.

DAMSONS (*Prunus damascena*)
Farleigh Damson – Prolific and dense in growth, so used as windbreak in windy Yorkshire and Kent.
Shropshire Prune Damson – Egg-shaped fruit, deep purple with dense bloom; richly flavoured.

GAGES (*Prunus italica*)
Count Althann's Gage – Originated in Hungary. Purple fruit with golden spots but without the fragrance of the green gages.
Denniston's Superb – 'Superb' is the word. A yellowish-green gage-plum sweet as honey. Of American origin.
Early Transparent Gage – Described as 'epicure fruit of highest quality'. Pale apricot yellow with white bloom and crimson dots.
Oullin's Golden Gage – Excellent flavour. Late blossoming helps frost-resistance.

ACTINIDIA SPECIES

Fruiting climbers from China and elsewhere in the Far East, the best known of which is the 'Chinese Gooseberry', which produces the small sausage-shaped, mini-melons now familiar in the shops as 'kiwi-fruits'. Extremely vigorous and said to be hardy. Bill Mollinson told me he had seen Chinese gooseberries climbing to the tops of tall trees in chilly parts of Tasmania. Dioecious, so male and female plants needed for fruiting. In China, Actinidia species are regarded as multi-purpose plants. Oil can be extracted from the seeds, the leaves are rich in starch, protein and vitamin C, the roots are used medicinally, the fibres are used in paper-making and the abundant resin is used for dyes and plastics.

CRATAEGUS SPECIES

The hawthorns are among the hardiest and most adaptable of all small trees and shrubs. The fruits, 'haws', are regarded as valuable heart tonics, and those of some of the many species that are found in many countries are commonly eaten. The best edible hawthorn, which I grow, is the Aze-

role (*azerolus*), a Mediterranean species, with comparatively large yellow or pinkish fruits shaped exactly like miniature apples. This little tree fascinates visitors, who also enjoy the fruit.

ELEAGNUS SPECIES

A genus of wind-hardy silvery shrubs or small trees related to the olives.

E. angustifolia – The Russian olive, wild olive or oleaster, has edible fruits. Cuttings were grafted by the Romans on to old olive trees to rejuvenate them, a practice that is mentioned in the Bible.

E. multiflora – Has oblong, ox-blood red fruits which are said to have a pleasant acid flavour.

E. umbellata – Has very fragrant flowers followed by small red or orange berries which are said to taste like red currants. Should be of particular value in a forest garden as it is shade-tolerant and is one of the few non-leguminous plants that fix nitrogen.

FICUS SPECIES

A vast genus of more than 600 species, of great nutritional importance in many countries.

Brown Turkey Fig – The hardiest variety, which has been successfully grown in England since the early Tudor period. Best against a southern wall, therefore a suitable subject for a patio garden.

GRAPES (*Vitis Vinifera*)

For forest garden purposes, grapes are best treated as climbers, occupying the vertical 'storey'.

Brant Vine – A very hardy Canadian variety, which produces small, aromatic, dark-purple fruit and whose foliage has good autumn colouring. I have Brant vines trained over the 'Boney Higgins' damson and the old privy opposite.

Vitis Coignetiae – Shows the most gorgeous autumn colouring when its large leaves turn brilliant scarlet and crimson. A very vigorous species that can climb to the top of the highest trees. Fruits black with purple bloom.

Strawberry Grape – I have one growing in the greenhouse, which produces small bunches of strawberry-jam-flavoured fruit. But the type can be grown out-of-doors.

JUNIPER (*Juniperus communis*)

One of only three British native conifers, the others being Scots pine and yew. Grown primarily for its berries, which have an essential oil of medicinal value.

MEDLAR (*Mespilus germanica*)

An old-fashioned tree with remarkable, exotic-looking brown fruit. The catalogues say that, while this fruit ripens on the tree in the Mediterranean, in Britain it only becomes eatable when 'bletted', that is, half-rotten. But a member of Hereford and Worcester Permaculture Group tells me he has an old medlar in his garden which gives prolific crops of ripe fruit.

MULBERRY (*Morus nigra and M. alba*)

Another old-fashioned tree, long cultivated in England, which, after some years, gives prolific crops of luscious fruit like large raspberries.

QUINCE (*Cydonia vulgaris*)

A tree with fruit like hard, yellow pears, which acquire a delicious fragrance when cooked with apples. The Spaniards make a tasty 'cheese' sold in flat slabs called *Dulce de Membrillo*, quince jam. Japonica is a climbing plant with showy orange-flame blossoms which produces fruit like small quinces.

RIBES SPECIES

This genus, which comprises gooseberries and black, white and red currants, is an essential constituent of any temperate forest garden, where it forms the backbone of the shrub layer. The bushes are woodland plants in their native state.

GOOSEBERRIES (*Ribes grossularia*)
A traditional form of agroforestry practised in the Fen area of Eastern England has been the growing of gooseberries in orchards. A feature of Lancashire life used to be giant gooseberry competitions and Roger's Nursery, Pickering, Yorkshire, still stocks many of the old Lancashire varieties. One with large, red, hairy fruit is called 'Dan's Mistake'. It recalls the *Schadenfreude* felt towards a fellow-competitor by a grower,

who won a prize with a bush which he had cultivated from a seedling which his friend had thrown away. Another generally available gooseberry with pink-purple hairy fruit, Whinhan's Industry, is particularly appropriate for the forest garden, as it is specially shade-tolerant.

BLACKCURRANTS (*Ribes nigrum*)
Some of the best modern blackcurrants have been bred in Scotland. Outstanding is Ben Sarek, which produces fruit as large and sweet as grapes. I have a Ben Sarek hedge along the western edge of the forest garden. Blackcurrants also feature in traditional agroforestry systems in the West Country, being interplanted with plums.

JOSTABERRY (*Ribes nigrum x grossularia*)
A blackcurrant-gooseberry cross of Dutch origin.

WORCESTERBERRY (*Ribes divaricatum*)
Once believed to be a similar hybrid but is now known to be a wild American gooseberry. It has small, deep-purple fruit which are very sweet.

ROSES (*Rosa*)

The *Rosaceae* are among the most important of all plant families. They include most temperate fruits: apples, pears, plums, cherries, raspberries, blackberries, among others. The roses themselves have exceptional medicinal value. They are regarded as a tonic for the whole system and especially for the heart. The hips are one of the richest sources of vitamin C, beneficial for female ailments, and make a delicious tea. Wild and traditional varieties of rose are more medically potent and often more fragrant than the sophisticated modern types featured at flower shows and dedicated to ladies of fashion and film-stars. What could be more refreshing than the scent of the humble sweet-briar of the hedgerows? The dog-rose is said to derive its name from the fact that the ancient Celts used it as a remedy for infected dog-bites and wolf-bites. The Bulgarians and Turks grow vast acreages of roses interplanted with garlic, which is said to enhance the fragrance required for the concentrated essence, *attar of roses*. Roses make delightful spots of colour in the forest garden. Of special interest are a number of historic roses, several of which feature on my Rose Mound.

Rosa gallica – Said to have been first bred 3,000 years ago in Persia. Much used by mediaeval herbalists.

Rosa mundi ('Apothecary's Rose) – striped red and white. Cultivated since at least 1310.

White Rose of York – Said to have been cultivated by the ancient Greeks and Romans. Used symbolically in the Wars of the Roses.

Provence Rose – Known as *'rose des peintres'* as it was a favourite of the seventeenth century Dutch artists.

Damask Rose – Introduced into Europe from Asia Minor in the sixteenth century.

Rosa Rugosa – Of Japanese origin. Has large, meaty, tomato-shaped hips that are very rich in vitamin C and can be eaten raw. Often used for hedging.

RUBUS SPECIES

This genus, which includes raspberries, blackberries and many well-known hybrid berries, is another that is basically essential to the forest garden. They include climbers, ground-cover plants and shrubs.

BLACKBERRIES (*Rubus ulmifolius*)
The most picturesque of the cultivated varieties is the parsley-leaved blackberry.

JAPANESE WINEBERRIES (*R. phoenicolaius*)
With red, hairy stems.

BLACKBERRY-RASPBERRY HYBRIDS
These include the well-known loganberry (*R. loganobaccus*) and Tayberry, a recent Scottish introduction with long, tapering fruits, and the Boysenberry (a visitor thought I said 'Poisonberry'. She exclaimed: 'Can you really *eat* them?')

RASPBERRIES (*Rubus idaeus*)
A Scottish speciality. An excellent variety that I grow is Glen Clova. A very late variety which I also grow is Autumn Bliss, that can fruit as late as December.

GROUND-COVER PLANTS
Among *Rubus* species that spread horizontally are the dewberry (*R. caesuis*), the Japanese strawberry-raspberry, *R. illecebrosus*, *Rubus tricolor* and *Rubus nutans*.

THIMBLE-BERRY (*R. parviflorus*)
A vigorous shrub whose fruit, like large raspberries, is relished by the Indians of America's North-West.

SALMONBERRY (*R. spectabilis*)
Another shrub from the same area, whose magenta blossoms appear as early as February, to be followed by large orange berries. It is sometimes called Cloudberry, but that name strictly belongs to a low shrub that grows in the heathlands of the Far North and is much appreciated for its berries in Scandinavia and Finland.

SORBUS SPECIES

A number of attractive small trees bearing currant-like fruits which should be explored by those who are interested in extending the boundaries of normal diet. Several have fruit that are acknowledged to be edible. Others have fruit that *may* be edible – brave pioneers might like to experiment! They include two of the rarest of all Britain's wild plants: *Sorbus arranensis*, which only grows wild in two glens on the Isle of Arran (of which I have a specimen), and *Sorbus birstoliensis*, which is only found in its wild state in the Avon Gorge.

ROWAN (*S. aucuparia*)
The familiar Mountain Ash, whose bitter but fascinating fruits are made into jelly by the Scots and are juiced by the Swiss. I have a variety officially pronounced to be edible – *Sorbus aucuparia edulis* – but its fruits are only a shade less bitter than those of the wild tree. However they are very rich in vitamin C, and, mixed with sweet fruit and a bit of honey, they make an intriguingly original fruit salad.

WHITEBEAM (*S. aria*)
Another native British tree. It has fruits without a trace of bitterness which are faintly reminiscent of old-fashioned fruitdrops.

WILD SERVICE TREE (*S. torminalis*)
Another rare British native, whose fruits used to be sold in markets in the Kent and Sussex Weald under the name of 'chequerberries'; they have been described as 'the most delectable of all England's wild fruit'. The Prime Minister's country residence gets its name from the fact that wild service trees grow in its grounds.

STRAWBERRIES (*Fragaria*)
In their native state strawberries are woodland plants, and the Victorians used to take a delight in growing them in old, disused coppices. They are said to benefit from a mulch of pine-needles; pine branches passed

through a shredder should be equally beneficial. Wild strawberries make an ideal constituent of the forest garden's ground-cover layer; they should be surrounded by a barricade of mulch to prevent them from being overwhelmed by invasive herbs or *Rubus* plants. F.C.King, the veteran Westmoreland gardener who pioneered the no-digging system and was an advocate of companion planting, claimed to have restored a clump of heavily diseased strawberry plants to perfect health by allowing them – temporarily – to become infested with weeds. I have grown climbing strawberries up a trellis in the patio garden.

SUMACH (*RHUS*)
The 'Stag's-horn' Sumach (*R. typhina*), with its hairy reddish branches and hairy crimson fruit, makes a striking feature on the edge of the forest garden. In America the fruit are soaked in water, when they produce a beverage similar to lemonade. The sumach belongs to the *Rhus* genus, which also includes the Japanese wax tree and the Japanese varnish tree. Among its more distant relatives are the pistachio and mango.

NUTS

The only nuts that are grown commercially in Britain are cobs (*Corylus avellana*) and filberts (*C. maxima*), but there is little doubt that other nuts could be grown with equal success if more trouble were taken to breed or import improved varieties.

SWEET CHESTNUT (*Castanea sativa*)
Marron de Lyon – Fruits at an earlier age and produces larger nuts than the 'Spanish' sweet chestnut commonly grown in Britain. After only two years my tree gave a fair crop of the characteristically spiny fruits – like small green hedgehogs. The large nuts sold in the shops are the result of intensive French breeding programmes to develop improved clones. The chestnut is a highly prized food in France, where it is made into the expensive delicacy, *marron-glacé*, and ground into flour to make bread and cakes. Chestnut trees have enormous potential value in agroforestry schemes as perennial 'tree-cereals', like the *Mesquite* trees whose beans are ground into flour by the Indians of the South-West United States. The sight of chestnut forests on Corsican mountainsides inspired J. Russell Smith to write his classic *Tree Crops - A Permanent Agriculture*, the pioneer work that led to the development of agroforestry in Japan and the West.

WALNUTS (*Juglans regia*)
The Common Walnut is a slow-growing tree which takes up to 15 years to come into bearing. It has been grown in England for many centuries, more for its highly prized timber than for its nuts. However, new clones have been developed, especially in Germany, for earlier fruiting and better quality nuts. I have one of these, called 'Buccaneer'.

BUTTERNUTS (*J. cinerea*)
An American member of the *juglans* genus, to which walnuts belong. A fast-growing tree with large, hairy leaves and exceptionally large nuts, of which I have a young specimen.

SHAGBARK HICKORY (*Carya ovata*)
An American member of the *carya* genus, allied to the walnuts, which is regarded as the most valuable nut that America produces. Difficult to establish and slow to grow, as it spends the first years of its life doing nothing but driving an enormously tough taproot deep into the soil. Once in full growth, its immensely strong timber, used for axe-handles, can resist almost anything that nature throws at it, including the ravages of the grey squirrel which tears the bark (hence 'shagbark').

AMERICAN OAKS (*Quercus spp.*)
A number of these have sweet acorns which can be eaten by human beings without boiling to eliminate the bitter tannins. The famous Scottish naturalist John Muir once said that an acorn cheese which he had been given by some Indians was the most sustaining and palatable survival food he had ever tasted.

NUT-BEARING CONIFERS
The Romans introduced nut-pines to provide rations for their troops. The umbrella-shaped form of the Stone Pine (*Pinus pinea*) is one of the characteristic features of the landscape of Italy, from which large quantities of *pignolia* pine-kernels are exported. There is little doubt that home-grown kernels could be a regular part of the British diet, if we took the same trouble to breed suitable varieties as we do to breed apples. The Stone Pine is suited to British conditions, especially in sandy and seaside districts. Among other nut-pines which are suited to our climate are the Swiss Arolla pine (*P. cembra*), of which I have a specimen, the Mexican nut-pine (*P. cembroides*), Gerard's pine (*P. gerardiana*) and the Digger pine (*P. sabiniana*). I also have specimens of two other nut-bearing conifers: the Ginkgo (*Ginkgo biloba*), a 'living fossil' which survived only as a temple

tree in China, and the 'Monkey-Puzzle' (*Araucaria araucana*)whose nuts are part of the staple diet of the Indians of Southern Chile.

VEGETABLES

As I explained in Chapter 13, very little fresh food can be expected from a temperate forest garden during the winter months, as most trees and bushes are bare, and herbs and perennial vegetables die down. The only exceptions are the hardy crabs, Golden Hornet and Crittenden, which retain their fruit till the new year, root vegetables and a few lingering herbs and weeds. Therefore forest gardeners who want regular supplies of fresh vegetables throughout the year must make a winter garden outside the forest garden precincts, which can also, incidentally be the home of some sun-loving herbs.

PERENNIAL VEGETABLES

ARTICHOKES, GLOBE (*Cynara scolymus*)
These giant thistles or their cousins, the cardoons (*C. cardunculus*), make a striking architectural feature growing at the edge of the forest garden.

ASPARAGUS (*Asparagus officinalis*)
A neighbour of mine grows asparagus in his herbaceous border, but it would be a mistake to allow this fussy and luxurious vegetable to disappear, even temporarily, amid the ordered chaos that is the forest garden in summer. It is best to plant the octopus-like 'crowns' in their own exclusive mound.

BAMBOO SHOOTS (*Graminaea*)
A small clump of bamboos makes an excellent forest garden feature, where it is useful for supplying canes for young trees. A number of temperate bamboos, which are members of the grass family, produce edible shoots. These include *Arundinaria simonii*, the 'bottle-brush' *Chusquea couleou*, *Phyllostachys bambusoides*, *P. flexuosa*, *P. nigra* and *P. mitis*, the most favoured source of the bamboo shoots served in Chinese restaurants.

BROCCOLI (*Brassica oleracea*)
Nine star perennial – I tried growing it from seed in the forest garden but, one snowy night, it was eaten to the ground by pigeons. However, three

plants appeared out of the blue in the AFG, possibly sowed with a useful accompaniment of manure by the same pigeons. I was not sorry to see its departure from the forest garden as, like other brassicas, it is too greedy and demanding to find a fit place in a co-operative community.

CHICORY (*Cichorium intybus*)
Useful, hardy, nourishing, mineral-rich, varied and visually attractive. The wild chicory, or succory, is a pasture herb with beautiful sky-blue flowers but otherwise similar in form and bitter flavour to the dandelion, which has long been used as a digestive tonic. Evelyn described it succinctly as 'more grateful to the Stomach than to the Palate'. But in recent years there have appeared in British shops and seedsmen's catalogues some of the many varieties of chicory that have been cultivated in Italy since Roman times. These, generally known as *radicchio*, are named after the towns and districts where they have been bred. Some are like compact lettuces and acquire beautiful shades of maroon and white in the autumn. Some even change shape; all are far less bitter than the wild succory. Many of them put out fresh leaves throughout the winter months, and are ideally suited to the cut-and-come-again system.

CHIVES (*Allium schoenoprasum*)
A cut-and-come-again onion, grown for its leaves. A variety recently introduced from the Far East is the Chinese Garlic Chive.

DANDELION, Cultivated (*Taraxacum officinale*)
Described as 'probably the most nutritious green there is. Very rich in minerals and vitamins'. Like chicory, its root can be roasted and ground for use as a caffeine-free coffee substitute.

GARLIC, wild, or RAMSONS (*Allium ursinum*)
One of the first leaves to appear in the forest garden in early spring. With its mild, sweet garlic flavour, it is, to my mind, the most delicious of salad ingredients.

GOOD KING HENRY (*Chenopodium bonus-henricus*)
A wild vegetable that has long been appreciated for its leaves that are cooked like spinach, and its asparagus-like shoots.

HORSERADISH (*Cochliaria armoracia*)
The young leaves have a taste similar to that of the well-known shredded roots, but far milder.

LOVAGE (*Levisticum officinale*)
In summer this pungent member of the celery family makes an impressive feature rising to three metres in the middle of the forest garden. Its leaves and stems give an original flavour to soups, stews and salads, but must be used with discretion.

LUCERNE, or ALFALFA (*Medicago sativa*)
This deep-rooted leguminous plant makes a very useful contribution of nitrogen to the forest garden. Its leaves can be served in salads and its seeds can be sprouted.

MITSUBA (*Cryptotaenia japonica*)
A hardy Japanese form of parsley, served raw in salads.

NETTLES (*Urtica dioica*)
No need to cultivate these! The job is to keep them under control, but the best way to do this is by eating the young leaves as soon as they appear. These are very rich in minerals and are surprisingly palatable if cooked briefly with potatoes or cereals such as sesame, quinoa or buckwheat. Nettles contribute to the forest garden's wild-life population by acting as food-plants for the larvae of several butterflies.

ONIONS, TREE (*Allium cepa bulbifarium*)
Grotesque plants with small bulbs at the tip of their stems.

ONIONS, WELSH (*A. fistilosum*)
Like large chives, but come from Siberia, not Wales.

SAMPHIRE (*Salicornia europea*)
An intriguing fleshy plant that must have been regarded as a great delicacy in Shakespeare's day as people risked their lives to pick it (see King Lear). Evelyn says of it: 'That growing on the Sea-Cliffs (as about Dover etc) not only pickl'd, but crude and cold, when young and tender... is in my Opinion, for its Aromatic, and other excellent Vertues and Effects against the Spleen, Cleaning the Passages, sharpening Appetite etc., so far preferable to most of our hotter Herbs and Sallet-ingredients that I have long wonder'd, it has not long since been propagated in the potagene.' Plants now available that should be grown in a light, well-drained soil.

SORREL (*Rumex acetosa*)
A form of spinach with a delightful mild lemon flavour.

SEAKALE (*Crambe maritima*)
A form of cabbage that must be one of the toughest plants in the world, as its natural habitat is shingle beaches, where it pushes down deep roots to reach the underlying soil. A favourite vegetable among the Victorians, who blanched the young shoots to produce a very tender asparagus-equivalent.

WATERCRESS (*Nasturtium officinale*)
It used to be thought that this popular vegetable could only be grown in running water, but now seeds are available that can be sown in moist soil.

ROOT VEGETABLES

Those most suited to the forest garden mound are either shade-tolerant plants such as Hamburg parsley (*Petroselinum crispum*) and some radishes, or winter roots that come into their own when the perennial herbage has died down. I can particularly recommend the Black Spanish radish (*Tragopogon porrifolius*), the purple French radish *Violet de Gournay* and Salsify (*Raphanus sativus*), the 'vegetable oyster'.

WINTER VEGETABLES

Among the many hardy annuals suitable for the Winter Garden which I have grown and can recommend are some less common vegetables:

CHARD, RUBY, or LEAF-BEET (*Beta vulgaris*)
Possibly the most beautiful of all vegetables, with its large, glossy scarlet-ribbed leaves.

ENDIVE (*Cichorium endiva*)
En Cornet de Bordeaux – an old French variety which provides constant cut-and-come-again throughout the winter.

KALE, or BORECOLE, PENTLAND BRIG (*Brassica oleracea*)
An old broccoli-like vegetable from North-East Scotland, where it was called 'The Green Doctor', as those who consumed it through the winter were believed to avoid illness.

LEEK (*Allium porrum*)
St. Victor – An old French variety with deep purple leaves.

LETTUCE (*Latuca sativa*)
Parella – One of the hardiest of all lettuces, from the mountains of Northern Italy.
Rouge d'Hiver – A decorative small French lettuce with reddish leaves.

MUSTARD (*Brassica juncea*)
'Green-in-the-Snow' – A piquant and super-hardy vegetable from China.

SPINACH (*Spinacea oleracea*)
Medania – An outstanding vegetable which, it is claimed, will stand the hardest winters.

HERBS

'The deft use of herbs transforms an ordinary salad into something rich, memorable and unique'. So writes Joy Larkcom in her inspiring book *The Salad Garden*. Herbs play many roles in the forest garden: as good companions for other plants, as attractants for beneficial insects, as medicaments, as flavourings and as foods in their own right. In that capacity we are returning to the practices of our forefathers, whose 'sallets' comprised a wide variety of herbs as well as vegetables and fruit. Herbs can be divided into those that in their natural state are woodland plants, and are therefore suitable for the forest garden, and those that naturally inhabit grasslands, sandy heathlands or rocky hillsides and therefore demand full sunlight. These can be planted in the 'Winter Garden'.

SHADE-TOLERANT HERBS

BALM (*Melissa officinalis*)
A small hardy shrub with delicious scent and flavour of lemon, which is said to 'radiate a beneficial influence all round.' John Evelyn described it as 'Cordial and exhilarating, sovereign for the Brain, strengthening the Memory and powerfully chasing away Melancholy.' Adds a stimulating nip to fruit salads.

BARBERRY (*Berberis vulgaris*)
One of the best liver tonics, because its bitter principle is more closely related to human bile than any other natural substance. Small shrub once cultivated for its edible berries. I have the cultivated form *Berberis thun-*

bergii with pink-purple leaves which makes an attractive patch of colour in the forest garden.

BORAGE (*Borago officinalis*)
Once you've had it, you've had it. Though an annual, there is no need to sow it more than once. A prolific self-seeder, it will crop up all over the place year after year. With its gay sky-blue flowers it is always welcome. The bees love it too. Hairy leaves reputed to 'taste like cucumber' but I can never see it. Another traditional antidote to melancholy.

BROOM (*Sarothamnus scoparius*)
Leguminous shrub adding valuable nitrogen to forest garden, where it thrives, even though its natural habitat is open ground. Flower buds used as caper-substitute. Yields yellow and green dye. Tonic and internal cleanser.

BUCKWHEAT (*Fagopyrum esculentum*)
Contains rutin, antidote to hardening of arteries. Attracts bees and other beneficial insects. Excellent soil improver. Cultivated in Northern countries for its very nourishing grain.

COMFREY (*Symphytum uplandicum*)
One of the most valuable and vigorous of herbs. Strengthens muscles and even helps to knit broken bones (old country name 'knitbone'). Contains mucilage used in lung disorders. Wonderful soil fertiliser. Should be eaten daily for positive health; its leaves lose their roughness if lightly cooked.

JACK-BY-THE-HEDGE (*Alliaria petiolara*)
Also called Garlic Mustard, which perfectly describes its flavour. Valuable wild herb with antiseptic leaves, which can be used in salads. Food plant of orange-tip butterfly.

LADY'S MANTLE (*Alchemilla vulgaris*)
Useful for forest garden ground layer. Traditional wound herb and treatment for feminine ailments.

MARIGOLD (*Calendula officinalis*)
Another wound herb still important today (calendula ointment). Flowers used in salads.

MARIGOLD, FRENCH and MEXICAN (*Tagetes spp.*)
Among the most important of companion plants, used for deterring

nematodes and aphids.

MINT (*Mentha spp.*)
The atmosphere of the forest garden is fragrant with the scents of the eight different varieties of aromatic mint that thrive there: applemint, curly mint, eau-de-cologne mint, gingermint, peppermint, pineapple-mint, spearmint and water-mint. It also has a non-aromatic mint, gipsywort, which shares the medicinal qualities of the others. The mints are both soothing and stimulating as well as good for the digestion. In Arab countries, where alcohol is banned, mint tea is the regular social drink.

NASTURTIUM (*Trapaeolum majus*)
Useful for forest garden vertical layer; trained up apple-trees, it is said to deter woolly aphids. Peppery leaves, rich in vitamin C, add zest to salads. Antiseptic.

SAGE (*Salvia officinalis*)
One of the most potent of herbs, especially effective in nervous complaints. As the Arabs drink mint tea, the Greeks drink sage tea. Dried sage delicious in stews.

SOAPWORT (*Saponaria officinalis*)
Known in America as 'Bouncing Bet'. Rich in saponin, a substance with valuable healing, cleansing and soil-conditioning qualities. If steeped in water, the plant acts as a natural detergent with none of the harmful qualities of manufactured detergents. As such it is still used for cleaning valuable fabrics, such as old tapestries. Decoction used for treating skin troubles.

SWEET CICELY (*Myrrhis odorata*)
Plant with lacy, aniseed-flavoured foliage, used as a general tonic. Removes some of the bitterness if cooked with sour fruit.

TANSY (*Tanacetum vulgare*)
Harshly aromatic herb that is said to be good companion for fruit-trees, as it deters harmful insects.

WOUNDWORT (*Stachys palustris*)
Wild member of Labiate (mint) family with attractive purple blooms and soft, downy leaves which were used to dress wounds in the Middle Ages.

SUN-LOVING HERBS

CATNIP (*Nepeta catoria*)
Intoxicates cats but deters rats. Traditional baby remedy for expelling wind and curing hiccups.

CENTAURY (*Centaurea spp*)
Pasture herb with lovely star-shaped pink flowers arranged in rosettes. Bitter tonic for blood and liver. Anglo-Saxons prescribed it for snake-bites.

FENNEL (*Foeniculum vulgare*)
Feathery leaves used for treatment of gastric ailments, cramp and rheumatism. Lotion used for eye troubles.

FEVERFEW (*Tanacetum partheneum*)
Tall white member of daisy family, used to treat migraine and feminine ailments.

GOAT'S RUE (*Galega officinalis*)
Tall, showy member of pea family (Leguminosae) said to promote milk-yield in goats and other mammals.

HOREHOUND (*Marrubium vulgare*)
Contains powerful substance called Marrubium which makes it a valued remedy for throat and lung troubles. I was told of a beekeeper who kept his hives in a clump of horehound and removed the supers as soon as the plants had ceased flowering. He kept the honey as a cough-mixture.

HYSSOP (*Hyssopus officinalis*)
Decorative small shrub which is also a superb bee-plant. Leaves contain sulphur, which makes them an excellent body-cleanser. Also nerve and eye remedy.

LAVENDER (*Lavendula angustifolia*)
Yet another bee-herb – bees are especially attracted to blue or blueish flowers. Deters harmful insects. Lavender-tea is a nerve tonic.

MARJORAM (*Origanum spp*)
Name means 'joy of the mountain', owing to its handsome pink-purple flowers. Much used as seasoning in Mediterranean cooking (*Origano*). Contains aromatic oil which aids digestion and expels impurities.

ROSEMARY (*Rosmarinus officinalis*)
Another characteristic Mediterranean herb which grows abundantly in *maquis* areas. Said to be good companion to vegetables, as it deters harmful insects. Yields camphorated type of dark green oil which has many medicinal uses, including treatment of high blood pressure and heart troubles. A former gypsy speciality was 'Queen of Hungary's Water', made from rosemary flowers and said to be general tonic and beautifier.

RUE (*Ruta graveolens*)
Acrid-scented plant with vivid blue-green leaves, especially appreciated in many parts of the Islamic world. Like buckwheat it contains rutin, which has been proved effective in strengthening blood-vessels, nerves and glands and hardening teeth and nails. Also used for treatment of nerves and feminine ailments. John Evelyn writes that Pliny 'reports it to be of such effect for the Preservation of Sight; that the Painters of his Time us'd to devour a great quantity of it.'

SOUTHERNWOOD or LAD'S LOVE (*Artemisia abrotanum*)
Sub-shrub with apple-scented leaves. Like other members of Artemisia family, contains a bitter principle called absinthol which is highly antiseptic.

TEASEL (*Dipsaeus fullonum*)
'You must grow teasels in your wildlife garden. The pollen from their tall elegant flowers turns the bumble bees pink and in the autumn charms of gold-finches will feed on the seeds.' So wrote Chris Baynes, the wild-life gardening expert. The teasel is a curious plant whose flowers are encased in a unique thorny receptacle, which has been used from time immemorial for dressing cloth, as it has been found impossible to reproduce it artificially. Another peculiarity of the plant is that it stores water in its leaves, which the gypsies believe has medicinal properties.

THYME (*Thymus spp.*)
This well-known aromatic shrublet contains an antiseptic oil called thymol which is used in many disinfectants, toothpastes and hair lotions. The plant provides safe remedies for many ills involving the nerves.

WORMWOOD (*Artemisia absinthium*)
A plant with grey leaves, an indication that it is relatively drought-resistant. In fact it is found in rocky and desert places. Like southernwood, another *Artemisia*, it contains absinthol, which should be used with dis-

cretion as a digestive tonic. It is a powerful repellent of harmful insects.

YARROW (*Achillea millefolium*)
This pasture herb owes its Latin name *Achillea* to the fact that its potency as a wound-healer is said to have been discovered by the Greek warrior Achilles. It is still used as the main ingredient of a healing salve.

WETLAND PLANTS

No garden is complete without a pond and a forest garden is no exception. If possible, room should be found for a pond to accommodate reeds, rushes and other useful water-plants, with an adjacent bog for fruits of *vaccinium* species which require moist conditions. My reed-bed contains the following plants:

ARROWHEAD (*Sagittaria sagittifolia*)
Plant with arrow-shaped leaves and edible tubers, for which it is commonly cultivated in China.

BULRUSH (*Scirpus lacustris*)
Young shoots are edible and leaves can be used for making mats and baskets.

FLOWERING RUSH (*Butomus umbellatus*)
A plant with bold, attractive pink flowers and edible seeds.

GALINGALE (*Alpina galangal*)
A decorative rush with umbrella-like leaves, whose roots were esteemed as a spice in the Middle Ages.

PONTEDERIA (*Pontederia cordata*)
A plant with up-standing heart-shaped leaves and fleshy spikes of blue flowers. The leaf-stalks are edible and the seeds can be eaten raw or ground, as a flour substitute.

REEDMACE (*Typhus latifolia*)
The familiar 'bulrush' with long brown flowering spikes on tall stalks. The flowers, young shoots and seeds are edible. The leaves can be used for

making hats and mats and the stems for paper-making.

My bog-gardens have been planted with cranberries (*Vaccinium macrocarpon*), swamp blueberries (*V. corymbosum*), cowberries (*V. vitis-idaea*), bog whortleberries (*V. uliginosum*) and *Vaccinium cylindraceum*, a rare shrub with cyclindrical flowers and blue-black edible berries from the Azores.

Appendix Two

Select list of plants suitable for tropical and sub-tropical Forest Gardens

This list should give some idea of the enormous variety of delicious and nutritious fruit, nuts, vegetables, herbs, spices and cereals, as well as other useful plants, that can be grown under tropical and sub-tropical conditions. If the forest gardens and other agroforestry systems that are now thriving in many tropical areas were widely extended, shortages and famines could be a thing of the past. By using such systems, many deserts and other deprived areas could be reclaimed and revived. Not only could the indigenous inhabitants be adequately fed, clothed, warmed and housed, but large surpluses could become available for export, so that more people on low incomes in the West could enjoy tropical products. There should be a greatly increased exchange of foods between the tropical and temperate zones, so that people throughout the world could enjoy the diversified diets that are essential for positive health.

The tropical rainforest has a far greater diversity of plants than any other ecosystem on earth – many of them not yet identified by science – and, if developed in a wise, sustainable way on forest garden lines, it can provide an equally wide diversity of foods and other useful products for the benefit of mankind. At the opposite extreme are the deserts, some almost completely devoid of vegetation, which cover about one-third of the world's land surface and many of which are rapidly spreading, in most cases owing to removal of tree-cover for firewood or to over-grazing. But these too can be reclaimed by agroforestry and other tree-planting methods, as has been proved by a number of countries, above all China. The first stage is to plant hardy, drought-resistant, deep-rooting plants that can tap any groundwater resources that may be available. Once these are established, they can be used to 'nurse' more tender crops, including fruit and nut trees.

The following lists include many plants that can flourish in sustainably developed rainforest areas, as has been proved by many successful forest garden schemes in India, Sri Lanka, Indonesia, East and West Africa, and also plants which can help to cause the deserts to 'bloom and blossom as the rose'.

FRUIT

AVOCADO (*Persea americana*)
This vegetable-fruit, native to Central America but now grown in many other tropical and subtropical countries, plays an important part in the diets of many people of those areas because of its exceptionally high content of protein, fat, vitamin A and vitamin B. Its flesh, which can be spread on bread like butter, is a valuable digestive tonic, tissue builder and glandular food. It is the fruit of a small to medium-sized tree which is particularly resistant to pests and diseases. An ideal forest garden constituent, it is one of twenty-five species featured in a diagram of a Guatemalan garden illustrated in Bill Mollison's *Permaculture One*.

BANANA (*Musa spp.*)
One of the principal components of the Chagga gardens of Tanzania, where cooked unripe bananas are a staple 'vegetable' and dried bananas, ground into flour, are sometimes used as cereal substitutes. Some bananas are also grown for their fibres and the leaves are used for thatching. So the banana is one of many examples of the ingenuity shown by indigenous peoples in finding multiple uses for staple plants. It is one of the most valuable of all foods, rich in minerals and vitamins as well as carbohydrates.

BREADFRUIT (*Artocarpus communis*)
Another vegetable-fruit, usually eaten roasted in the Pacific zone where it is native and where it is often consumed as a staple food. The fruit, like large melons with a thick, warty rind, grow on tall trees which may reach ninety feet. They have now become established in most parts of the tropics.

CARAMBOLA (*Averrhoa carambola*)
The ribbed, golden, juicy fruit of a small tree which originated in Indonesia and has spread to other parts of South-East Asia. It is used to prepare a refreshing drink.

CERIMAN (*Monstera deliciosa*)
Green, cone-shaped fruit of a Central American creeper, having incised leaves which are unique in the plant world and long aerial roots. The pineapple-flavoured juice makes a delicious drink.

CHERIMOYA (*Anona cherimolia*)
Another pineapple-flavoured fruit from the American tropics, which is also widely grown in Asia. The fruit, which has a thick scaly skin, is very popular in the areas where it is grown.

CUSTARD APPLE (*Anona squamosa*)
A closely related fruit with a custard-like consistency, also known as Sweet Sop, which is very popular in the West Indies.

DATE (*Phoenix dactilifera*)
One of the most nourishing of foods, which is believed to be the oldest of all cultivated plants. A single tree, during its lifetime of 200 to 300 years, can produce up to 600 pounds of fruit a year. A component of agro-forestry schemes in desert oases and of forest gardens in Bangladesh, it is one of the supreme multi-purpose trees, every part being utilised. It has been estimated that over 800 articles can be made from it. The sugary sap has valuable medicinal qualities; dry dates are ground into a cereal-equivalent flour; the stones are roasted and ground to make date coffee; young leaves are eaten as vegetables; older leaves are woven into mats and baskets; the fibres are made into ropes and brushes; the timber is used for building houses and dhows; the stalks are used as fuel.

DATTOCK (*Detarium senegalense*)
A fruit consisting of a pod with a sweet, farinaceous pulp, which is common in parts of tropical Africa. An edible oil can be extracted from the seeds. The tree furnishes a valuable timber, sometimes called 'African mahogany'.

DURIAN (*Durio zibelhinus*)
A fruit whose taste and smell have been the subject of some extremely uncomplimentary descriptions including 'custard passed through a sewer' and 'old cheese and onions flavoured with turpentine'. However, an odourless variety is said to have been discovered, and it has been suggested that this might be the subject of a breeding programme to produced a fruit acceptable to world commerce. The tree, which can reach a height of 100 feet, is the main component of the canopy of the Maninjau forest gardens of Sumatra, where it is grown in association with cinnamon.

EUGENIA (*spp.*)
A large genus of tropical and subtropical fruits, with glamorous names such as rose-apple, Java jambosa, rumberry, arrayan, maigang, pitanga tuba, surinam cherry and uvalha.

FIG (*Ficus spp.*)
An enormous number of species of fig, cultivated and wild, grow in the tropics. Figs are rich in energising fruit-sugars as well as vitamins and minerals, including iron, which means that they are especially beneficial for the blood. A combination of calcium, potassium and sodium, which figs contain, is said to make them a valuable aid to normal heart action and the efficient functioning of the nervous system, as well as preventing lung and chest complaints.

GRAPEFRUIT (*Citrus paradisi*)
Appeared 'out of the blue' in the eighteenth century West Indies, apparently as a result of cross-pollination between oranges and pomelos, the largest of all citrus fruits, that are native to South-East Asia and pips of which were deposited in Barbados by an English sea-captain named Shaddock in 1696. The grapefruit contains two particularly valuable substances, a form of quinine, which is helpful in the treatment of malaria and feverish colds, and biotin, which is a useful slimming agent.

GUAVA (*Psidium guajava*)
Has spread from the American tropics to become one of the most commonly planted tropical fruits. An occupant of the low-tree layer of forest gardens in Kerala, India, Valued for its particularly high content of vitamin C.

INDIAN GOOSEBERRY (*Emblica officinalis*)
Another component of the Kerala forest gardens. One of the most widely appreciated fruits in tropical Asia, both for its nutritional and medical uses. One of the richest sources of vitamin C. When virgin land is cleared wild Indian Gooseberry trees are always left standing. In Thailand buses stop in the countryside to allow passengers to pick the fruit to quench their thirst.

JACKFRUIT (*Artocarpus integrifolia*)
Probably the largest of all fruit, weighting up to seventy pounds. Related to breadfruit; despite its strong odour it is relished cooked or raw. Component of forest gardens in Nigeria and Kerala.

JAMBOLAN (*Syzygium cumini*)
Somewhat acid, plum-like fruit of one of the most popular of tropical ornamental trees. Especially favoured as avenue tree in India. Flowers, rich in nectar, yield high-quality honey. Hardy; tolerates both drought and flooding.

JUJUBE (*Zizyphus jujuba*)
Prolifically produced farinaceous fruit of one of the world's hardiest trees, that can withstand severe heat, frost and drought. Another tree-cereal, that can also be made into a butter or a cheese. Wood used for making sandals. One of the few trees that is host to the lac insect, resinous encrustations from which are used to produce shellac and lacquer.

KUMQUAT (*Fortunella spp.*)
Like a small orange; not a true citrus but closely related. Specially prized in China because it can stand cold better than oranges.

LEMON (*Citrus limon*)
Excellent source of phosphorus, the mineral which is essential for the healthy functioning of the nervous system, and one of the few fruits that is a good source of calcium, necessary for sound teeth and bones.

LITCHI (lychee) (*Litchi chinensis*)
Mainly grown in tropical and subtropical parts of China, where it is much esteemed as the last course of the traditional Chinese dinner. Like a small plum with pinkish-crimson warty rind, enclosing a translucent jelly-like substance with a 'sweet-and-sour' flavour.

LOQUAT (*Eriobotrya japonica*)
Another Chinese native; one of the few subtropical members of the *Rosaceae* family, which includes many of the most important temperate fruits such as apples and pears. Like a small golden pear, about the size of and similar in flavour to a John Downie crab.

MANGO (*Mangifera indica*)
The best-known fruit grown in India, where enormous quantities are produced – for export. An Indian friend tells me that the ordinary Indian seldom sees one. However the forest gardeners of Kerala and Bangladesh are careful to include mangoes in their planting schemes. One of the most prolific of fruit trees; a single big old tree is said to be capable of producing a bumper crop of 35,000 – enough to feed a whole town! Like many other tropical and subtropical trees, it can function as a tree-cereal, the large kernels being dried and ground into flour. 'Mango butter' is made from half-ripe fruit.

MANGOSTEEN (*Garcinia mangostana*)
Sometimes described as the most delicious of all tropical fruits, with a

plum-like texture surrounded by a thick purple rind. Not as widespread as it could be, largely because the small tree is slow to grow and fruit. Research has been suggested into the possibilities of improving its performance.

NARANJILLA (*Solanum quitoense*)
'The golden fruit of the Andes', related to but wholly unlike the tomato. The juice is said to taste like a mixture of strawberries and pineapple. Much like an orange in appearance, the fruit grows on a large, robust, hairy shrub and is produced throughout the year.

OLIVE (*Olea europea*)
Fruit of a small, slow-growing tree that often lives to a great age in fairly arid areas. Oil used medicinally, both internally and externally, as well as for lighting, lubrication and soap.

PAPAYA (*Carica papaya*)
Oval, melon-like fruit of one of the world's fastest-growing plants. Looking like a small palm, it is in fact a woody, herbaceous plant with a crown of large leaves on top of a straight, unbranched trunk. It can bear quite a heavy crop of fruit within a year of seeding. The fruit has a delicate aroma and a taste that contains elements of strawberry, peach and Gallia melon. It is particularly appropriate for use in a forest garden context, because its unripe fruits may be eaten as a perennial green vegetable, thus reducing the need for annual vegetables requiring constant cultivation of the soil. An enzyme called papain that is present in latex extracted from the unripe fruits has important medicinal and industrial applications. One use of it is as an anti-shrinking agent for textiles. From the leaves a medicinal alkaloid called carpaine is extracted and the seeds yield a useful oil. The plant will not tolerate chemical fertilisers, so it has to be grown organically.

PASSIONFRUIT (*Passiflora edulis*)
One of the most delicious of all fruit and one of the most beautiful of all flowers; as a perennial climber it is one of the components of the vertical layer in the Kerala forest gardens. The fruit has a purple skin enclosing a sweet fragrant pulp, from which a popular beverage is extracted.

PINEAPPLE (*Ananas comosus*)
The fruit, which is in fact a fusion of 100 or more small fruits, has important nutritional and medicinal virtues owing to its content of magnesium and manganese, both of which benefit the nervous system. It is also a good source of vitamins A and C, which work together to build up the

body's protective system. The juice contains a digestive enzyme similar to papain and can be applied externally to treat skin complaints. The juice is also a useful remedy for sore throats. From the sharp, sword-shaped leaves a strong fibre can be extracted, which can be woven into hard-wearing cloth.

POMEGRANATE (*Punica granatum*)
The fruit of a small tree or shrub notable for its vivid, flame-coloured blossoms, which yield a red dye. The most useful part of the fruit is the sweet but astringent juice extracted from the translucent, pink pulp, which has many medical applications. A jet-black ink can be made from the leathery rind.

POMELO (*Citrus grandis*)
This largest of the citrus genus thrives in the lowland tropical zone, unlike other members of the group which require subtropical climates. Another peculiarity of the species is its high tolerance of salinity, which makes it a plant with great potentialities for exploiting barren seacoasts. In Thailand, its main centre of cultivation, it is grown round river deltas and in brackish marshes. The Thais claim that the salt in the soil and atmosphere enhance the flavour.

RAMBUTAN (*Nephelium lappaceum*)
Another product of the tropical lowlands, where its 'sweet-and-sour' taste is very popular. Related to the litchi, the fruit is similar in size and colour, but strikingly adorned with soft spines.

TAMARIND (*Tamarindus indica*)
A bean with an acid-sweet pulp that is borne by a long-lived leguminous tree, which thrives in tropical coastal regions where it is known for its resistance to hurricanes. It is used as an ingredient of sauces, chutneys and beverages. The pods, when immature, as well as the young leaves and flowers, are consumed as perennial vegetables. Another valued component of Kerala forest gardens.

UVILLA (*Pourouma cecropiaefolia*)
A wild grape-like fruit of the Amazon rainforest, borne in abundance during the wet season and much appreciated by the Indians. A publication of the National Academy of Sciences, Washington, suggested that it should be the subject of research, to see if it is suitable for a 'homegarden' (or forest garden) crop throughout the humid tropics.

NUTS AND OILSEEDS

BABASSU PALM (*Osbignya phalerata oleifera*)
Another of the many wild trees of the Amazon rainforest, which has been largely neglected by science but which is potentially of enormous value to mankind. A tall, majestic, fan-shaped palm with large elegant, curved leaves, it is widespread in many parts of the Amazon basin. It bears huge crops of nuts very similar to coconuts, which are extremely rich in an oil that is both edible and has industrial uses, especially in the manufacture of soap. The only disadvantage is that the shells are very tough, but a machine has been built that can crack them. Babassú palms are sometimes grown as components of forest garden schemes in Northern Brazil.

BAMBARA GROUNDNUT (*Voandzeia subterranea*)
Named after a district near Timbuktu in the Sahara, this is an extremely nourishing protein food that will grow in some of the harshest deserts, where few other plants will survive, but also in the African rainforests. Like the peanut, the plant buries its fruits in the ground, where they are safe from flying insects such as locusts. The seeds are eaten raw when immature or boiled or roasted, when fully ripe. Roasted seeds are often ground into a flour that is considered to be as energising as most grains. Bambara groundnut is thus one of many tropical plants that are cereal-equivalents, whose cultivation avoids the complications involved in growing conventional cereals and which lack the gluten which is a cholesterol-forming agent in wheat, oats, barley and rye. Bambara groundnut has proved to be suitable for mixed cropping in West African forest gardens.

DIKANUT (*Irvingia gabonensis*)
Edible fruit of multi-purpose tree grown on the 'compound farms' of South-East Nigeria. Oil is extracted from kernel, which is also valued as a soup condiment, as are also the fermented seeds. The leaves, roots and bark have medicinal properties. The hard timber is used for making tool handles and for carving.

JEHEB NUT (*Cordeauxia edulis*)
One of the few food-plants able to survive in the arid wastes of the Sahel. It has a very deep taproot able to search out any groundwater that may be available and which enables the plant to remain green throughout the year. A dwarf, many-stemmed shrub, the jeheb grows slowly, especially in

the seedling stage while it is establishing its massive rood system. But after three to four years, under favourable conditions, it will yield abundant harvests of pods containing seeds of rich and well balanced nutritive value. The leaves contain a vivid red dye. The jeheb is ideally suited for establishing pioneering outposts for agroforestry schemes designed to reclaim the Sahara and other deserts.

OIL PALM (*Elaeis guineensis*)
An important constituent of the Nigerian 'compound farms'; also widely grown in other parts of West Africa. The orange-red nuts form tightly compacted bunches shaped something like pineapples. Harvesting of mature trees, which may reach fifty feet, is usually by climbers supported by ropes wound round the trunks. The oil is very nutritious, being especially rich in carotene, the precursor of vitamin A. It is also used for soap-making. A sugary sap is extracted from the trunk and flowers and the fronds are used for thatching.

PEACH PALM (*Bactris utilis*)
A tropical American species that produces extremely nourishing nuts similar to chestnuts. A multi-stemmed tree, it is considered especially suited for the production of 'hearts of palm' or 'palm cabbage', a vegetable delicacy.

VEGETABLES

The most important vegetable crops grown in many parts of the tropics are beans and other pulses, because they tend to be the principal sources of protein.

LABLAB BEANS (*Dolichos lablab*)
Among the most ubiquitous and adaptable of tropical legumes, and also among those best suited for agroforestry schemes, as they are already widely used as cover crops in rubber, coconut and oil-palm plantations. Not only are the dried seeds eaten as pulses, but the young pods and leaves are eaten as green vegetables.

MARAMA BEANS (*Tylosema esculentum* or *Bauhinia esculenta*)
Natives of the Kalahari Desert and adjacent regions of southern Africa, these beans rival soya beans and peanuts in protein and oil content. The fruits of long, prostrate vines, they are eaten roasted or ground into flour. A golden oil similar to almond oil is extracted from the seeds. The plants

also have enormous red-brown succulent tubers which are particularly appreciated, not only for their food value but also as emergency sources of water.

MOTH BEANS (*Phaseolus aconitifolius*)
Believed to be the most drought-tolerant pulse crop grown in India, these beans are extensively cultivated in the Rajasthan Desert area. Thriving in periods of minimal rainfall, the plants form dense mats which create a living mulch, shielding the soil from the sun and conserving moisture. As such they would be good companions for other plants in agroforestry desert reclamation schemes. The seeds make a nutritious pulse and the young pods are eaten as chlorophyll-rich vegetables.

TEPARY BEANS (*Phaseolus acutifolius*)
Another drought-tolerant crop, these beans have been cultivated in arid zones of North America for more than 5,000 years. Today they are among the staple foods of the Hopi and Papago Indians. In their wild state they are tall vines which often climb up desert shrubs, but under cultivation they tend to form self-standing shrubs. Rich in protein, the beans are either treated as pulses or ground into meal.

WINGED BEANS (*Psophocarpus tetragondolus*)
Native to New Guinea and South-East Asia, these are multi-purpose plants, every part of which – seeds, pods, leaves and tubers – are edible. Exceptionally rich in protein, the seeds also yield an edible oil. They also contain tocopherol, an anti-oxidant that increases the viability of vitamin A in the human body (vitamin A deficiency is common in many tropical regions). Fast-growing perennial vines, the plants are exceptionally resistant to pests and diseases.

Among tropical root and tuber crops, taros (*colocassia antiquorum*) and yams (*dioscorea spp.*) have been found to be more suitable for forest garden conditions than the ubiquitous cassava (*Manihot utilissima*), because they are more shade-tolerant. Farmers in the Kenya Highlands train their yams up strong and hardy *mururi* trees, which they plant as living stakes. Another valuable climber is the Central American *chayote (Seculum edule)*, a vigorous perennial vine with curious ribbed, pear-shaped fruits, every part of which, like the winged bean, is edible. Another perennial Central American vegetable is the similarly named *chaya*, which, for years on end, produces prodigious quantities of greenery that is consumed like spinach.

WAXES, GUMS & FIBRES

Though the industrial world produces a large number of synthetics from petrochemicals and other sources, natural substances are preferable. Not only are they often more efficient, containing elements that cannot be reproduced artificially, but – important in this age of ecological crisis – their production and processing do not pollute the environment and they are derived from resources that are readily and easily renewable. A few examples:

CANDELILLA (*Euphorbia antisyphilitica*)
A leafless shrub that grows abundantly in the deserts of Mexico and the southern United States, whose stems exude a wax that is used as a substitute for beeswax. When refined, it is used in the manufacture of candles, polishes, varnishes, dental moulds and electrical insulating materials. The wax is removed from the plants by boiling or the use of solvents. In Mexico the candelilla industry is subsidised by the government, as a way of supporting inhabitants of remote desert regions.

CAUASSU (*Calatea lutea*)
A tall herb, having large wax-coated leaves, that grows in dense clumps along the banks of the Amazon and other rivers in South and Central America, as well as in upland areas. The wax, for which there is considerable industrial demand, can be removed easily, without mechanical aids; so wax-production would be a good subject for small communal enterprises, associated with forest gardens, such as those of Kerala.

GUAR (*Cyamopsis psorialiodes*)
A leguminous bush with gum-bearing seeds, related to the soya bean, which grows in tropical Asia. There is a constantly rising demand for the gum from paper-making, food-processing, pharmaceutical, mining and oil industries. A robust plant which thrives in semi-arid areas and tolerates saline soils, guar has been cultivated in India for centuries as a food-crop. The seeds are rich in protein, while the young pods are eaten like French beans or dried and salted.

JUTE (*Corchorus capsularis*)
A perennial fibre plant that thrives in low-lying tropical areas such as Bangladesh. An extremely versatile fibre, it can be processed into many different types of thread including one resembling wool. With sponsor-

ship from Oxfam and other relief agencies, a large network of co-operatives has been set up to help Bangladeshi women to make knitwear and other jute-based articles of many kinds. Jute leaves can be eaten like spinach.

RAMIE (*Boehmeria nivea*)
Formerly called 'Chinese Grass', this is a tall, slender, perennial fibre plant that thrives in humid tropical and subtropical regions of East Asia. Harvested from two to five times a year, it can continue to yield good fibres for 100 years. Its use in China goes back to neolithic times. The fibres are long, strong, durable and almost as lustrous as silk. With tensile strength seven times that of cotton, they can be used for parachute cords, fire hoses, transmission belts and other products where strength is essential. Blended with terylene, they form a permeable fabric that is ideal for tropical clothing.

FUEL CROPS

Wood is the main fuel used throughout most of the Third World, and it is regaining popularity in the West as concern is rising over the environmental pollution caused by fossil fuels. Trees most likely to prove useful for energy plantations are those of 'pioneer' species which, under natural conditions, colonise deforested areas. Such trees are hardy, aggressive, adaptable and able to stand degraded soils, drought and strong winds. In tropical areas many of the best firewood trees are fast-growing members of leguminous species, able to fertilise themselves with atmospheric nitrogen. Ability to coppice or re-grow from root-suckers are other useful characteristics. Attention should also be given to the calorific value of different woods. In general, heavy woods give off more heat than soft woods, though the resins in conifers enhance heat when burning, as do the oils and gums sometimes found in hardwoods.

CASUARINA (*Casuarina equisitefolia*)
A native of the Southern Hemisphere, this hardy, fast-growing, salt-tolerant tree produces wood which has been described as 'the best firewood in the world'. In India it has even been used to fuel railway engines. Equally at home in the humid tropics, semi-arid regions, on high mountain slopes and coastal sand-dunes, it is commonly used for erosion control. Having an abundance of switchy twigs, it makes an excellent wind-break. Though not leguminous, it has the ability to fix atmospheric nitrogen.

GLIRICIDIA (*Gliricidia sepium*)
A fast-growing, coppicing leguminous tree from tropical America, it is planted not only for fuel but to shade plantation crops such as cacao, as it has an abundance of foliage. As such it is well suited for agroforestry schemes. A notable feature of the tree is that, though its wood is used for fuel, the living tree is relatively fireproof. As such it is commonly used in Java for fire-belts round forests.

GMELINA (*Gmelina arborea*)
A native of the rainforests of South-East Asia, this high-yielding, adaptable, coppicing tree has been planted for fuel in many tropical countries, including Brazil and parts of Africa. It has been used as the main tree constituent of *taungya* systems, in which short-lived horticultural crops, such as cashews, peanuts, corn and beans, are planted in the neighbourhood of saplings during their period of establishment. Its pulp is used for high-quality paper.

LEUCAENA (*Leucaena leucocephala*)
Probably the most popular 'pioneer' tree planted in the tropics in recent decades. Amazingly fast-growing, it can reach heights exceeding twenty feet in its first year. Especially high-yielding varieties have been planted in the Philippines to supply fuel for power stations. With an aggressive root system that can split rocks and an ability to thrive on steep, barren slopes, it has been used to restore forest cover to denuded watersheds. A legume originally from southern Mexico, it has become a truly pantropical tree.

PONGAM (*Derris indica*)
Another leguminous tree, originating from the Indian sub-continent, pongam is planted to provide, not only fuel but also lighting oil. Being shade-tolerant it could be a constituent of the low-tree layer in a forest garden. The dried leaves are ground into derris powder, which is used as an insect and nematode deterrent.

WETLAND PLANTS

A number of useful plants grow on lakes, in rivers or in marshes, and many such areas, at present totally neglected, could be made the sites of interesting and exciting agroforestry/permaculture schemes.

BURITI PALM (*Mauritia flexuosa*)
Growing by the million in swampy areas throughout Amazonia, this valuable tree was described by the famous naturalist Alexander von Humboldt as 'the tree of life', because it supplied all the basic needs of several Indian tribes. It has bunches of sweet, tangy fruit which are reported to contain as much vitamin C as citrus and an oil containing even more vitamin A than carrots or spinach. The kernel contains another oil which is reported to be similar in quality to that of the oil palm. From the pith of the trunk is obtained a starch similar to sago, which is roasted by the Indians to make bread. The trunk also contains a sweet sap and the unopened flower clusters are edible like vegetables. The bark is a light wood like balsa, which the Indians use to make rafts. A cork-like material obtained from the leaf-stalks has been used to make sandals and the leaves contain a fibre which has been used for hammocks, mats and baskets.

LOTUS (*Nelumbrium nuciferum*)
This water-plant which grows wild in many parts of Asia is the sacred lotus of Indian and Chinese mythology. The rhizomes are roasted or steamed and are said to taste like Jerusalem artichokes. In China a kind of arrow-root is sometimes prepared from them. The seeds are usually boiled or roasted, the fruit can be eaten after the removal of the seeds and the stems and bell-shaped leaves can be eaten as green vegetables in salads.

PAPYRUS (*Cyperus papyrus*)
Another water-plant, now scorned in Africa as a pernicious weed, which once played a key role in the civilisations of Egypt, Greece and Rome, In order to make the writing-material used for the masterpieces of classical literature, the ancients stripped the fibrous covering off the stems and slit the pith into strips. Laid side by side, with other strips placed crosswise on top, the strips were dampened and pressed, so that the glue-like sap cemented them together; they were then dried into sheets. From the outer fibres of the stems, the Egyptians made ropes, baskets, mats and sails; the roots were used as fuel and the pith was eaten. The papyrus reed could be used for all these purposes today, and yet it is regarded as a scourge that should be destroyed. It forms floating islands in lakes that obstruct navigation and a large area of Uganda is papyrus swamp which is rejected as a useless wilderness. All this vast quantity of papyrus could be used to make paper, hardboard and rayon and so save thousands of square miles of forest from destruction.

SPIRULINA (*Spirulina platensis* or *S. maximus*)
Another lake plant: a blue-green alga which forms vast sheets on the surface of lakes in Mexico and Chad in Africa, where for centuries it has been dried and consumed as a high protein food-additive. It is now being produced on a small scale commercially. The marching ration of Aztec warriors.

WATER-CHESTNUT (*Trapa natans*)
An attractive aquatic plant which produces large, curiously-shaped nuts like buffalo's horns, which are eaten raw, boiled or roasted like ordinary chestnuts. The Chinese water-chestnut is an entirely different plant, cultivated for its round, edible corms.

WATER-SPINACH (*Ipomea aquatica*)
A tropical, trailing herb which grows in lakes and marshes in India, South-East Asia, Taiwan and southern China, where it is widely cultivated for its edible leaves and stems. A quick-growing plant, it may be harvested more than ten times in a season. Relatively high in protein for a green vegetable, it has been estimated that a single hectare could produce 770 kilograms of protein per year – a simple answer to the protein-deficiency problem which dogs the people of many tropical regions with vast unused wetlands.

EELGRASS (*Zostera marina*)
An amazing flowering cereal that grows in shallow seawater, and which has been harvested for centuries by the Seri Indians of the west coast of Mexico. The plant grows fully submerged, but when the grain is ripe it floats to the surface and drifts to shore. An important mud-flat stabiliser, zostera is considered to have great potentialities as a food-crop for tropical estuaries.

DROUGHT-RESISTANT PLANTS

Deserts are estimated to cover an area the size of North and South America and are rapidly expanding, and yet large areas of them could be reclaimed by agroforestry techniques, using some of the many plants that have developed remarkable mechanisms enabling them to survive in areas of minimum moisture. Kew Gardens has a data-base which lists 500 species that have 'green glue' attributes. The basic essential of such plants

is an extensive and quick-growing root system that can enable the plant to be rapidly established, stabilise shifting sands and extract any water that may be available. Extensive surface-growth is also desirable to halt sheet and wind erosion as well as to shade the soil and other less heat-tolerant plants. Several such plants have already been mentioned; others include:

ACACIA SENEGAL
One of the hardiest trees in the world, found throughout the Sahel, in many parts of which it is the only woody species able to survive. A small thorny tree or bush, it can thrive in the poorest rocky or sandy soils and face up to hot, dry winds and sandstorms. Stated to be 'highly suitable for agroforestry systems', it is already widely grown in association with crop-plants including water-melon and millet, the principal dryland cereal. Its principal product is gum-arabic, a multi-purpose adhesive for which it has been cultivated for at least 4,000 years.

ALBIZIA LEBBEK
Another tropical leguminous tree with an open, spreading canopy that is already used extensively in agroforestry schemes: as a shade and nurse tree in cocoa and timber plantations, as the top storey in forest gardens devoted mainly to pineapples, bananas, other fruit trees and bamboos, and as a living stake for pepper vines. A native of tropical Asia, Africa, South America and northern Australia, it is sometimes known as 'Woman's Tongue Tree'.

CAROB (*Ceratonia siliqua*)
A sub-tropical leguminous fruit-cereal that can thrive on rocky slopes with no visible soil. It is commonly planted on hillsides above orange groves. Originally a native of the Near East, the bean-like fruit is believed to have been the 'locusts', which, with wild honey, sustained John the Baptist in the wilderness. The mucilaginous pulp is a particularly sustaining food as it is almost fifty per cent sugar. A confection made from it is sold as 'St. John's Bread'. An industrially valuable gum is extracted from it. A single large tree can produce a ton of pods and remain productive for 100 years.

CHRIST THORN (*Zizyphus spina-christi*)
A long-lived bush or small tree that flourishes in the Sahel-Sahara area of Africa and the Arabian Desert, and is notable for its exceptional regenerative powers. It owes its name to the fact that it is believed to have sup-

plied Christ's crown of thorns. Because it develops an extremely deep taproot and wide-spreading lateral roots, it is used for stabilising sand-dunes. It is also used for windbreaks and shelterbelts. The foliage is eaten by camels. The wood, said to be termite-proof, is used for cabinet-making and household utensils and burns with intense heat.

MESQUITE, or ALGAROBA (*Prosopis juliflora*)
A tree-cereal native to Central America which produces long straw-coloured pods which, when ground into flour, are a palatable substitute for maize-meal. A thorny, deep-rooted, leguminous bush or tree, it has been planted in many arid or semi-arid tropical zones.

MOPANE (*Copaifera mopane*)
A characteristic tree of many arid parts of Africa, where it sometimes forms pure stands called 'Mopane woodland'. The scented, butterfly-shaped leaves are rich in protein. The wood is exceptionally hard, being used for bridge-piles and railway sleepers. It burns very slowly, giving off intense heat.

NEEM (*Azadirachta indica*)
A multi-purpose tree native to the dry forest areas of the Indian sub-continent and South-East Asia, neem is one of the most valuable of all arid-zone trees. It produces high-quality timber similar to mahogany and tougher than teak. The seeds are up to forty per cent oil, which is used both for burning and for lubrication. Extracts from the seeds, leaves, bark and roots have medicinal and toiletry application. The seeds and leaves also contain an insect repellent called *azadirachtin*. In northern Nigeria, neem has been the subject of a successful *taungya* experiment; after being interplanted with groundnuts, beans and millet, the trees showed markedly superior growth.

PIGEON PEA (*Cajanus cajun*)
A leguminous woody shrub grown in many parts of the tropics which has great importance as a producer of perennial vegetables in arid areas. As a pulse, the dried seeds are rich in protein while the immature pods are often eaten as greenfoods.

RED RIVER GUM (*Eucalyptus camaldulensis*)
One of two eucalypts which are most widely planted throughout the tropical and subtropical world. Extremely adaptable, it will flourish in areas of both low and high rainfall. In the Sudan it is planted to protect crops

from blowing sand. With a wide-spreading crown it is a valuable shade tree.

TAMARUGO (*Prosopis tamarugo*)
A leguminous evergreen tree related to the mesquite, this is the most remarkable arid-zone tree in the world. It grows in the Atacama desert of northern Chile, where the soil is covered by a salt-crust several metres thick. Rain is sometimes absent from the area for seven years, but the tree is able to extract moisture from the atmosphere through its leaves by a process called 'reverse transpiration'. The leaves, pods and seeds are nutritious and palatable.

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Many of the permaculture titles listed are available from Permanent Publications, Hyden House Ltd, Little Hyden Lane, Clanfield, Hants PO8 0RU. Tel 01705 596500; Fax 595834. The UK distributors of Bill Mollison's books, and many other books, manuals and videos on permaculture and sustainable systems design, are Éco-logic Books, 19 Maple Grove, Bath BA2 3AF. Tel 01225 484472; Fax 01179 420164.

Besides this book and the *Forest Gardening with Robert Hart* video (see p. 204), Green Books publish and distribute many other titles on organic gardening & farming, ecological building, renewable energy etc. For a catalogue please phone us on 01803 863260; Fax 863843.

Recommended Suppliers in the UK

Agroforestry Research Trust, Dartington, nr. Totnes, Devon, TQ9 6JT.
Chris Bowers and Sons, Wimbotsham, Norfolk PE24 8QB (fruit, nut and ornamental trees and bushes and strawberries).
Chiltern Seeds, Bortree Stile, Ulverston, Cumbria LA12 7PB (uncommon vegetable, herb, tree and shrub seeds).
Deacon's Nursery, Godshill, Isle of Wight PO38 3HW (fruit trees and bushes, 'family' trees).
Future Foods, Gastard, Corsham, Wiltshire, SN13 9QN.
Harley Nursery, Harley, nr. Much Wenlock, Shropshire SY5 6LP (fruit trees and bushes and ornamentals).
Heritage Seed Programme, HDRA, Ryton-on-Dunsmore, nr. Coventry, CV8 3LG.
Highfield Nurseries, Whitminster, nr. Gloucester GL2 7PL (trees, fruit trees and bushes).
Hillier Nurseries, Ampfield House, nr. Romsey, Hants SO51 9PA (largest selection of trees and shrubs in the world).
Hollows Nursery, Prescott, nr. Cleobury Mortimer, Kidderminster, Worcs. DY14 8RR (fruit trees and bushes and ornamentals).
Kent Country Nurseries, Challock, nr. Ashford, Kent TN25 4DG (fruit bushes, mushroom spawn).
S.E. Marshall and Co., Wisbech, Cambs PE13 2RF (perennial vegetables, soft fruit).
Ken Muir, Weeley Heath, Clacton-on-Sea, Essex CO16 9BJ (fruit and nut trees and bushes, strawberries).
Nordy Bank Nursery, Clee St. Margaret, nr. Craven Arms, Shropshire SY7 9EF (herb plants).
Nutwood Nurseries (nuts), School Farm, Onneley, nr. Crewe, Cheshire, CW3 9QJ.
Plants for a Future, The Field, Penpol, nr. Lostwithiel, Cornwall, PL22 0NG.
Poyntzfield Herb Nursery, Black Isle, by Dingwall, Ross and Cromarty IV7 8LX (herb plants and seeds).
R.V. Roger, The Nurseries, Pickering, N.Yorks YO18 7HG (fruit trees and bushes and ornamentals, especially Lancashire gooseberries).

Scott's Nurseries, Merriott, Somerset TA16 5PL (fruit, nut and ornamental trees and bushes, perennial plants, and a wide range of traditional fruit trees).
Clive Simms, Woodhurst, Essendine, nr. Stamford, Lincs PE9 4LQ (uncommon fruit trees).
Suffolk Herbs, Monks Farm, Coggeshall Road, Kelvedon, Essex CO5 9PG (organic vegetable and herb seeds).
The Willow Bank, Llanry Ylin, nr. Caersws, Powys, SY17 5RJ.

Membership Organisations

The Permaculture Association has a strong involvement in forest gardening. They offer a members' Newsletter, annual conference, and information sheets on courses, contacts and events. Membership £10 p.a. Write to *BCM Permaculture Association, London, WC1N 3XX, or telephone 0845 458 1805* (10am - 4pm, Mondays to Thursdays). *www.permaculture.org.uk*.

The Henry Doubleday Research Association (HDRA), the leading centre for organic gardening in the UK, has a Forest Garden open to the public. *HDRA, Ryton-on-Dunsmore, Coventry CV8 3LG. Tel 024 7630 3517. www.gardenorganic.org.uk*.

The Agroforestry Research Trust has set up an experimental forest garden on the Dartington estate near Totnes. Their Newsletter gives information about tree and shrub crops, fruit varieties to grow, and information about other agroforestry projects.They also have an extensive catalogue of publications, and sell plants and seeds. Newsletter subscriptions £21 p.a. for four issues. *Agroforestry Research Trust, 46 Hunter's Moon, Dartington, Totnes, Devon TQ9 6JT. www.agroforestry.co.uk*.

The Soil Association campaigns to improve quality of food, health and the environment by promoting organic agriculture. Offers membership and a Newsletter. *The Soil Association, South Plaza, Marlborough Street, Bristol BS1 3NX. Tel 0117 314 5000. www.soilassociation.org*.

FOREST GARDENING
WITH ROBERT HART *DVD*

Some thirty years ago, the late Robert Hart had a vision of planting a small food-producing forest, which could fulfil the needs of a healthy diet and at the same time create a beautiful and ecologically-sound environment. He based his ideas on tropical forest gardens, which combine maximum output with minimum labour. Robert's garden on the Welsh border served as a model of what can be achieved in any backyard.

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FOREST GARDENING

Revised and updated edition

"Progress is a spiral; the pendulum swings back as well as forward. The new post-industrial world, for which many of us are striving, will see an ecological renaissance, a rebirth of all that was best in 'primitive' life and outlook, blended with new potentialities at which we can only guess." – Robert Hart

Forest gardening is a way of working with Nature which is not only productive and requires minimal maintenance, but creates great environmental benefits. As Herbert Girardet says in his Foreword: "Robert Hart was a rare person. . . . For decades he waged a lonely battle for life, patiently writing books and articles and quietly planting trees on his small farm in Shropshire. Robert created a magnificent forest garden which had a profound influence on the way many people have cultivated their own patches of land. It was a garden dedicated to human needs for fruit, nuts, vegetables and plant medicines. But it was at the same time a celebration of the myriad interactions of life; for it was based on profound observations, both intuitive and scientific, of how different life forms interact in order to stimulate and support one another."

Forest Gardening includes guidelines on how to design and maintain a forest garden, and details of recommended species for temperate, tropical and sub-tropical climates. This new edition includes additional appendices, and details of new developments by the author and other practitioners.

Robert Hart's other books include *The Inviolable Hills*, *Ecosociety*, and the widely-acclaimed *Forest Farming* (co-authored with James Sholto Douglas).

Cover painting by Frans Wesselman R.E.

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